CIVIL AND ENVIRONMENTAL ENGINEERING

Graduate Program Director

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Program Description

Civil and environmental engineers apply scientific and engineering knowledge to protect and improve the infrastructure, public health, and the natural and built environment. Graduate study in Civil and Environmental Engineering (CEE) provides students with advanced scientific and engineering knowledge in their field of interest and develops their abilities to formulate solutions to new and complex problems in the context of current social, global, environmental, and economic considerations. These objectives are accomplished by flexible plans of study designed to meet the needs of individual graduate students. Graduates find fulfilling careers in public and private industries and consulting practices, and are prepared for doctoral-level work leading to research/teaching careers. The program includes thesis, non-thesis, and management plans. The CEE graduate program offers advanced courses in all five sub-disciplines:

- Structural engineering
- Geotechnical engineering
- Transportation engineering
- Environmental engineering
- Water resources engineering

Facilities for advanced study and research are located in Moser Hall, which houses a variety of well-equipped laboratories. These include the Graduate Students Lab, Strength of Materials Lab, Hydraulics/Fluid Mechanics Lab, Environmental Engineering Lab, Geotechnical Engineering Lab, and Concrete Mixtures Lab. In addition, the college computer lab provides access to a large number of modern PCs equipped with high-speed internet connections and latest software for modeling in various fields of research in Civil and Environmental Engineering. The Graduate Students Lab is equipped with state-of-the-art computers and necessary software for research modeling.

Admission Requirements

DEGREE PROGRAMS

Applicants must meet all of the general requirements for admission to the College of Graduate Studies. Admission to the program is selective and based on the qualifications of the applicant, the needs of the program, and the availability of funding. Applicants with lesser qualifications may be granted provisional graduate student status based on the evaluation of their undergraduate records, standardized test (e.g. GRE) results, work experience, and other professional qualifications.

The Master of Science in Engineering may be characterized as being both career-oriented and flexible. Program plans are available to accommodate the needs of nearly every engineering graduate student. Graduate students enrolled in any of the engineering graduate programs must complete:

- 30 semester hours for the thesis plan,
- 33 semester hours for the non-thesis plan, or
- 36 semester hours for the management plan.

The degree requirements consist of core courses, technical courses, and thesis or project courses. The management plan also requires a series of business courses. These degree programs are designed to provide graduate students with the knowledge and skills necessary to excel in professional careers and/or pursue a PhD or doctoral degree in engineering. To obtain a list of core and technical course requirements for a particular engineering discipline, students should contact the Graduate Program Director for the program of interest.

Program Plans

Thesis Plan

Graduate students choosing the thesis plan are required to complete 30 semester hours of graduate coursework. This generally consists of:

- 6-9 semester hours of core courses,
- 15-18 semester hours of technical concentration courses, and
- 6 semester hours of thesis.

This plan is strongly recommended for all candidates, who wish to continue their graduate studies beyond the master's degree. The thesis provides firsthand experience with experimental design, literature searches, research methodology, technical report writing, and oral presentation of research results. Additionally, the thesis option can lead the graduate student to a higher level of expertise in the chosen area of specialization. Students enrolled in this plan is required to have a thesis proposal approved by the faculty and the Graduate Program Director before the end of their second semester into the Civil and Environmental Engineering (CEE) graduate program.

Non-thesis Plan

The non-thesis plan is designed for students who wish to enhance their knowledge and skills to succeed in careers as practicing engineers, but are unlikely to pursue a PhD or doctorate degree. A total of 33 semester hours of coursework is required for this plan. In addition to 6-9 semester hours of core courses, every student enrolled in this plan is required to complete 21-24 semester hours of technical courses related to their discipline, and a 3-semester-hour graduate project. Students enrolled in this plan is required to have a project proposal approved by the faculty and the Graduate Program Director before the end of their second semester into the CEE graduate program. A graduate student enrolled in a graduate project course will be required to defend the results of his or her project by giving a presentation to the engineering faculty and students.

Management Plan

Students who have been in the work arena and are moving into an engineering management role may wish to choose the management plan. A total of 36 semester hours of coursework is required for this plan. This consists of:

- 6-9 semester hours of core courses,
- 9-12 semester hours of business courses,
- 12-18 semester hours of technical courses, and
- 3-semester-hour graduate project.

Students enrolled in this plan is required to have a project proposal approved by the faculty and the Graduate Program Director before the end of their second semester into the CEE graduate program. A graduate student enrolled in a graduate project course will be required to defend the results of his or her project by giving a presentation to the engineering faculty and students.

Civil and Environmental Engineering Requirements

At the time of initial enrollment, the student will select a program plan (thesis, non-thesis, or management) and research area (structural, geotechnical, transportation, environmental, water resources) available through faculty expertise. The requirements for each program plan are listed in the general description of the Master of Science in Engineering program. Lists of required courses and possible electives for each plan may be obtained from the Graduate Program Director.

In cooperation with an assigned faculty advisor and the Graduate Program Director, each student will establish a set of academic goals and desired outcomes, and a coursework plan to meet those objectives. Graduate students

must meet the Graduate Program Director each semester before registering for courses. Upon completion of the graduate program, all students will complete either a written or an oral assessment of the effectiveness of the program in meeting their established goals and outcomes.

Thesis students, who have registered for all required thesis hours and have completed all course requirements but have not finished the thesis, are required to maintain current student status if they expect to utilize any University service (e.g., parking, computers, library, advisors' assistance, thesis defense, etc.). This can normally be accomplished by registering for at least one semester hour of thesis credit.

Non-thesis students must complete a graduate project under the guidance of a faculty member. Students with management option should consult the Graduate Program Director and the faculty advisor to develop their coursework plan.

COURSE	TITLE	S.H.
Core Courses		
MATH 6910	Advanced Engineering Mathematics 1	3
MATH 6911	Advanced Engineering Mathematics 2	3
Technical Courses (only one course outside the CEE graduate program is allowed)		
CEEN 5820	Pavement Material and Design	3
CEEN 5829	Civil Engineering Materials - Concrete	3
CEEN 5832	Natural Systems Engineering	3
CEEN 5836	Environmental Water Chemistry	3
CEEN 5837	Environmental Engineering Design	3
CEEN 5849	Structural Analysis 2	3
CEEN 5855	Reinforced Concrete Design	3
CEEN 5856	Steel Design	3
CEEN 5869	Design of Air Pollution Control Systems	3
CEEN 5880	Advanced Hydraulics	3
CEEN 5882	Foundation Engineering	3
CEEN 5883	Bridge Engineering	3
CEEN 5884	Solid and Hazardous Waste Management	3
CEEN 6956	Advanced Soil Mechanics	3
CEEN 6958	Structural Dynamics	3
CEEN 6965	Special Topics	3
CEEN 6967	Biological Treatment Processes	3
CEEN 6973	Watershed Modeling	3
CEEN 6977	Hydrology	3
CEEN 6979	Water Quality Modeling	3
CHEN 5820	Industrial Pollution Control	3
ENST 5830	Toxicology and Risk Assessment	3
GEOG 6901	Introduction to Geographic Information Science	3
GEOG 6903	Advanced Geographic Information Science	3
MECH 5884	Finite Element Analysis	3
Choose one:		
CEEN 6990	Thesis	6
CEEN 6989	Graduate Projects	3

Student Learning Outcomes (SLO): Civil and Environmental Engineering

At the time of graduation from the Civil and Environmental Engineering graduate program, students should be able to demonstrate:

(a) advanced technical knowledge in one or more civil and environmental engineering subdiscipline(s)

(b) proficiency in scholarly research

(c) effective oral and written communication skills

CEEN 5820 Pavement Material and Design 3 s.h.
Design methods for flexible, rigid and other wheel-supporting pavements to include investigation, testing and preparation of subgrade, base course and pavement materials, design of various pavement mixtures, stresses in pavements, pavement design, and strengthening existing pavements.
Prereq.: CEEN 3720 and CEEN 4881.

CEEN 5829 Civil Engineering Materials - Concrete 3 s.h.
A course designed to broaden the student's understanding of Portland Cement Concrete as a construction material. Topics include the study of cement, hydration of cement, aggregates, admixtures for concrete, mix design handling and placing, curing and properties of Portland Cement Concrete. Testing of Concrete, quality control and special concretes are also included. A library research paper on a concrete-related topic of the student's choice is required.
Prereq.: CEEN 3749 or permission of instructor.

CEEN 5832 Natural Systems Engineering 3 s.h.
Introduction to the features, functions and values of natural aquatic systems, and engineering approaches to analysis and restoration design. Focus on wetlands and streams. Topics include regulations, wetland delineation, constructed wetland design, basic stream geomorphology, and stream restoration design.
Prereq.: CEEN 3736 or permission of instructor.

CEEN 5836 Environmental Water Chemistry 3 s.h.
Fundamental principles and calculations of major chemical reactions and equilibriums that occur in aquatic environments, and water/wastewater treatment processes.
Prereq.: CEEN 3736.

CEEN 5837 Environmental Engineering Design 3 s.h.
Theory and design of unit operations and processes for treatment of drinking water and municipal wastewater.
Prereq.: CEEN 3736.

CEEN 5849 Structural Analysis 2 3 s.h.
Analysis of statically indeterminate beams, trusses, bents and multistory frames, utilizing concepts of strain energy, virtual work, slope-deflection, and moment distribution. Introduction to matrix methods of analysis using force and displacement methods.
Prereq.: CEEN 3749.

CEEN 5855 Reinforced Concrete Design 3 s.h.
An introduction to the behavior, analysis, and design of reinforced concrete members. Included are singly and doubly reinforced beams, tee-beams, slabs, short and long columns.
Prereq.: CEEN 3749.

CEEN 5856 Steel Design 3 s.h.
An introduction to the behavior and design of steel structures. Included is the design of rolled and built-up tension members, beams, columns, beam-columns, welded and bolted connections.
Prereq.: CEEN 3749.

CEEN 5869 Design of Air Pollution Control Systems 3 s.h.
Engineering analysis, procedures, and techniques for the selection, applications and operation of air pollution control methods in various operational situations.
Prereq.: CEEN 3736.

CEEN 5877 Systems Engineering and Project Management 3 s.h.
Systems approach to engineering design; non-linear models; linear programming; dynamic programming; network analysis; project management.
Prereq.: MATH 3705.

CEEN 5880 Advanced Hydraulics 3 s.h.
Application of hydraulic principles for one dimensional river modeling; understanding the fundamental processes of open channel hydraulics; application of HEC-RAS/HEC-GeoRAS models for river system modeling.
Prereq.: A "C" or better in CEEN 3717.

CEEN 5882 Foundation Engineering 3 s.h.
Analysis and design of various foundations, including abutments, piers, piles, and footings; slope stability of embankments.
Prereq.: CEEN 4881 and CEEN 5855.

CEEN 5883 Bridge Engineering 3 s.h.
Analysis and design of concrete and steel bridges; specifications and code requirements; design detailing; effects of natural and man-made hazards on bridges; implications of bridge failures.
Prereq.: CEEN 5855 and CEEN 5856.

CEEN 5884 Solid and Hazardous Waste Management 3 s.h.
Sources, characteristics, handling and disposal options for solid waste and hazardous waste; topics include regulations, health effects, waste minimization, collection systems, landfill design, treatment and processing methods, and site assessment.
Prereq.: CEEN 3736.

CEEN 6910 Advanced Strength of Materials 3 s.h.
The basic methods of structural mechanics, such as conditions of equilibrium and compatibility, stress-strain relations. General treatment of energy principles including virtual work, minimum potential energy; applications to statically determinate and indeterminate systems such as rings, curved beams, plates, and other elastic systems.

CEEN 6920 Wetlands Engineering 3 s.h.
Wetland characteristics-soils, hydrology, and vegetation; wetland functions and values; regulations; planning, theory, design and construction of created and constructed wetlands; applications in wetland mitigation, wastewater treatment, and pollution control.
Prereq.: CEEN 3736 Fundamentals of Environmental Engineering or equivalent.

CEEN 6921 Groundwater and Surface Water Modeling 3 s.h.
Mathematical simulation of hydrodynamic processes and pollutant transport in subsurface and surface water environments.
Prereq.: CEEN 3716 Fluid Mechanics and CEEN 3736 Fundamentals of Environmental Engineering.

CEEN 6930 Sediment and Contaminant Transport 3 s.h.
Understanding of sediment and contaminant transport in fluvial environments. Topics include sediment characteristics, incipient motion, scour, bankfull discharge, advection, and mixing.
Prereq.: CEEN 3717 or equivalent.

CEEN 6941 Structural Mechanics 3 s.h.
Study of beams under lateral load; beams with combined lateral load and thrust; buckling beams on elastic foundations; applications of Fourier series and virtual work principles to beam type structures; stress and strain in three dimensions; applications to flexure of beams and plates and to constrained torsion; elements of engineering theory of plates.

CEEN 6947 Finite Element Analysis 3 s.h.
An introduction to finite element techniques as applied to problems in structural mechanics. Direct and variational methods of element formulation with application to beams, beam columns, frames, arches, thin plates, and shells.

CEEN 6951 Construction Project Management 3 s.h.
An integrated approach to construction project management. Advanced topics of Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) and its application in construction project scheduling. Resource allocation and leveling, construction cost control, computer simulation of construction operations, and expert systems construction.

CEEN 6952 Foundation Engineering 3 s.h.
Principles of mechanics of materials applied to foundation problems; stresses and deformations in soils, consolidation theory; shallow and deep foundation design.

CEEN 6953 Flow Through Porous Media 3 s.h.
Analysis of seepage volume and stresses due to flow of water through soils in connection with dams, slopes, excavations, subsurface drainage, and wells.

CEEN 6956 Advanced Soil Mechanics 3 s.h.
Development of shear strength theories, Mohr-Coulomb-Hvorslev equation, critical path concept, stability of slopes, lateral earth-pressure theories, development of bearing capacity equations.
Prereq.: CEEN 4881 or equivalent.

CEEN 6957 Structural Stability 3 s.h.
A study of the elastic stability of engineering structures, beam columns, static buckling of elastic beams, frames, plates, and shells, dynamic stability of beams and plates.

CEEN 6958 Structural Dynamics 3 s.h.
Analysis of the response of structures to air blasts and earthquake motions; development of both the normal mode and frequency response methods in dealing with periodic and nonperiodic excitations.

CEEN 6959 Advanced Steel Design 3 s.h.
Advanced topics in the structural design of girders, frames, and trusses. Light gauge metal structures. Use of modern alloys and hybrid systems.

CEEN 6961 Advanced Concrete Design 3 s.h.
Consideration of advanced design techniques for reinforced concrete members and structures such as composite and prestressed concrete beams, box girders, and slabs.

CEEN 6965 Special Topics 3 s.h.
The application, in civil engineering, of special topics selected by the faculty from fields of current research interest or special emphasis. May be repeated up to six semester hours.

CEEN 6967 Biological Treatment Processes 3 s.h.
Theory and design of biological processes used in the treatment of municipal and industrial wastewaters, and in the remediation of hazardous wastes.
Prereq.: CEEN 3736.

CEEN 6972 Advanced Topics in Environmental Engineering 3 s.h.
Advanced concepts related to the transport, reaction, phase distribution, and fate of pollutants in both the natural environment and treatment systems.
Prereq.: CEEN 3736.

CEEN 6973 Watershed Modeling 3 s.h.
Application of hydrologic principles for modeling point and non-point source pollution at the watershed scale; the nutrient and sediment transport simulation using SWAT model; understanding the fundamental processes of pollutant movement through the soils and overland flow; application of data driven modeling in Water Resources Engineering.

CEEN 6975 Physical and Chemical Treatment Processes 3 s.h.
Theory and design of physical and chemical processes used in the treatment of water supplies, wastewater, and hazardous wastes.
Prereq.: CEEN 3736.

CEEN 6976 Design of Small Dams 3 s.h.
Flood routing, reservoir engineering. Hydraulic design of small gravity, earth fill and rock fill dams, spillways, and energy dissipaters.
Prereq.: CEEN 3717 and CEEN 6977.

CEEN 6977 Hydrology 3 s.h.
Precipitation; hydrologic abstractions; runoff; urban and small watershed hydrology; frequency analysis; digital simulation.

CEEN 6978 Water Resources Policy and Management 3 s.h.
International, national, and local water resources case studies, laws, policies, and management strategies are discussed. The need and demand for water; technical, economic, financial, social, environmental, and political considerations; data requirements; multipurpose projects.

CEEN 6979 Water Quality Modeling 3 s.h.
Mathematical modeling of physical, chemical, and biological processes in natural systems; development of computer models to simulate the fate and transport of pollutants in lakes, streams, and estuaries; application of models to evaluate water resource management options.
Prereq.: CEEN 3736 Fundamentals of Environmental Engineering.

CEEN 6989 Graduate Projects 1-3 s.h.
Special projects involving research, analysis, design, or other independent investigation, undertaken by the M.S. student under the direction of a graduate faculty member with the approval of the department chair. Credit will be determined in each case based on the nature and extent of the project.

CEEN 6990 Thesis 1-9 s.h.
Hours arranged. May be repeated.