11.6.4 DEPARTMENT OF CIVIL, CONSTRUCTION AND ENVIRONMENTAL ENGINEERING (CCEE)
Head: Professor Kenneth Fridley, Office: 262 H. M. Comer Hall

The department offers programs leading to the master of science in civil engineering, master of science in engineering (environmental engineering), and doctor of philosophy degrees in civil engineering. Research programs in the department include urban environmental quality and water resources; management and safety of transportation systems; infrastructure development, assessment, renewal, and protection; and construction engineering and management. Laboratory facilities are provided for graduate research and instruction in these and other areas.

Admission Requirements

The requirements for admission to the Graduate School are detailed in section 4.4 of this catalog. The Department of Civil, Construction and Environmental Engineering also embraces the requirements of the College of Engineering, summarized as follows:

1. An applicant must have earned a baccalaureate degree from an institution accredited by the Engineering Accreditation Council (EAC) of ABET, inc. and have a grade point average of at least 3.0 on a 4.0 scale, or at least 3.0 for the last 60 hours completed.
2. Applicants who are not graduates of EAC/ABET-accredited programs must have Graduate Record Examination general test scores of 1000 or higher and grade point averages of 3.0 or higher on a 4.0 scale.

Degree Requirements

Master of Science Degree Requirements
The basic requirements for both the master of science in civil engineering and master of science in engineering (environmental engineering) are identical. A total of 30 hours is required for a master's degree, consisting of at least 24 regular course hours and 6 or more thesis research hours for Plan I students. The student's advisor and supervisory committee work with the student to define an appropriate plan of study that meets all degree requirements, including any prerequisite or preparatory work and a core set of courses as required and specified by each specialty area. Students are required to pass a comprehensive exam or thesis defense administered by the student's supervisory committee.

Thesis Option (Plan I): 30 Credit Hours

Plan of Study (minimum of 30 credit hours)

- 6 hours of CE 599 Thesis Research
- 3 hours of CE 593/693 Practicum
- 21 hours of approved coursework
  - 9 hours of core coursework (see below)
  - 6 hours maximum of approved 400-level courses
  - 12 hours maximum of approved transfer credit
  - 15 hours minimum of CE courses
• Thesis Committee and Defense
  o Minimum of three graduate faculty, with the majority from the department and at least one member from outside the department
  o Maximum of two attempts to pass defense
  o The Committee may require additional prerequisite courses (not allowed as part of the Plan of Study) for those students without an ABET/EAC-accredited degree
• Maximum of 6 years to complete degree requirements

Non-Thesis Option (Plan II): 30 Credit Hours

Plan of Study (minimum of 30 credit hours)

• 0-3 hours of CE 593/693 Practicum
• 0-3 hours of CE 598 Non-Thesis Research
• 24-30 hours of approved coursework
• Approved Coursework (24-30 hours)
  o 9 hours of core coursework (see below)
  o 6 hours maximum of approved 400-level courses
  o 12 hours maximum of approved transfer credit
  o 18 hours minimum of CE courses
• Comprehensive Exam and Committee
  o Minimum of three graduate faculty, with the majority from the department
  o Maximum of two attempts to pass exam
  o The Committee may require additional prerequisite courses (not allowed as part of the Plan of Study) for those students without an ABET/EAC-accredited degree
• Maximum of 6 years to complete degree requirements

MSCE Core Coursework Requirements (9 hours)

• Construction Engineering and Management
  • CE 573
  • CE 567
  • CE 568

• Structural Engineering and Materials
  • CE 573 – Statistical Applications in CE
  • CE 534 – Advanced Structural Mechanics
  • CE 531 – Structural Dynamics

• Environmental and Water Resources Engineering
  • CE 573
  • CE 525
  • CE 524, CE 527, CE 585, CE 575 or CE 570

• Transportation Systems Engineering
  • CE 573
  • CE 558
  • CE 559 or CE 556

See the Master's Degrees Graduate School requirement section of this catalog for additional information.
Course Descriptions

Master's students may, with permission of the department and approval by the Graduate School, receive credit for six hours of 400-level credit. No 400-level courses can be approved for application to a PhD degree, other than the maximum of 6 hours already completed as part of a master's degree. A master's student may, with approval of a petition, meet prerequisites with a combination of related coursework and experience.

**CE 511 Advanced Rock Mechanics.** Three hours.
Prerequisite: AEM 250.
Advanced levels of theories of rock failure, ground movement, stability analysis, and the design of underground openings; rock testing methods.

**CE 515 Advanced Engineering Economics.** Three hours.
Prerequisite: IE 203 or CE 366; and GES 255 or GES 400 or 500
Not open to students with credit for CE 415. Capital budgeting decision making under risk and uncertainty, utility theory, cost estimation, and design of financial control through management simulation.

**CE 516 Advanced Information Systems Design.** Three hours.
Prerequisite: CE 414 or equivalent.
Not open to students with credit for CE 416. Current concepts in information systems architecture and applications, including decision support systems and expert systems. Emphasis placed on expanded use of systems design methodology.

**CE 517 Advanced Project Management.** Three hours.
Prerequisites: IE 203 or CE 366; and GES 255
Not open to students who have credit for CE 417. This is an engineering management course designed to introduce students to the functions of project engineers and managers. It details the processes of planning and controlling project scope, time, and cost.

**CE 518 Engineering Management.** Three hours.
Prerequisite: CE 366
Not open to students who have credit for CE 418. An introduction to management principles, and the management functions of planning, organizing, motivating, and controlling. Management of engineers in research, design, manufacturing/construction, and quality will be studied.

**CE 522 Solid and Hazardous Waste Management.** Three hours.
Prerequisite: CE 320 or B.S. degree in a compatible field.
Engineering design and regulatory requirements for the collection, storage, recycling, treatment, and disposal of solid wastes.

**CE 523 Effects and Fates of Hazardous Chemicals Released to the Environment.** Three Hours.
Prerequisites: CE 520; CE 378; & CE 425 or permission of instructor.
Chemical fate and transport in the environment. Frequency and magnitude of accidents involving hazardous material. Effects of these releases on the community.

**CE 525 Air Pollution.** (3-0) Three hours.
Prerequisite: AEM 311 or CHE 304.
Introduction to the source, characteristics, and effects of air pollution and to air pollution control technology and design.
CE 526 Physical/Chemical Processes in Water and Wastewater Treatment. Three hours.
Prerequisites: Graduate standing and course in differential equations; or permission of the instructor.
Discussion of fundamentals of physical/chemical processes, as they relate to environmental quality and water and wastewater treatment. Reactor principle, chemical processes, and particle removal process will be discussed from fundamental theory.

CE 527 Storm Water Management. Three hours.
Prerequisites: CE 378 and CE 475 or permission of instructor.
Quality and quantity of urban storm water. Receiving water problems and sources of pollutants. Runoff quality and quantity characteristics. Selection and design of controls; regulations.

CE 529 Environmental Systems Analysis Three hours.
Prerequisites: CE 320 and CE 424.
Advanced examination of tertiary, physical, and chemical unit operations used in water and wastewater systems.

CE 532 Advanced Structural Analysis. Three hours.
Prerequisite: CE 331.
Introduction to the matrix-displacement method of analysis for framed structures, including computer implementation of analysis. An introduction to finite-element analysis is also included.

CE 534 Advanced Structural Mechanics. Three hours.
Prerequisite: CE 331 or graduate standing.
Introduction to advances structural mechanics topics, including elementary elasticity, elementary beam theories, beams on elastic foundations, energy methods, buckling and free vibration of beams, and elementary thin-plate theory.

CE 536 Wood Structural Design. Three hours.
Prerequisite: CE 331.
Modern timber engineering: design of beams, columns, trusses, and floor systems.

CE 537 Reinforced Concrete Structures II. Three hours.
Prerequisite: CE 433.
Design of reinforced concrete building components including two-way slabs, slender columns, prestressed beams, slap-on-grade, and retaining walls.

CE 538 Structural Steel Design II. Three hours.
Prerequisite: CE 434.
Basic and elementary design procedures for steel structures such as plate girders, mill buildings, multistory buildings, highway bridges, and light-gauge steel structures.

CE 539 Design of Masonry Structures. Three hours.
Prerequisite: CE 539
Design of un-reinforced and reinforced masonry walls, columns, pilasters, beams and lintels.

CE 542 Waste Containment Facilities. Three hours.
Prerequisite: CE 340 or permission of instructor.
Introduction to the fundamentals of soil behavior as they relate to environmental engineering.
Topics include soil behavior, soil compaction, conduction phenomena, geosynthetics, and aspects of landfill design.

**CE 544 Foundation Engineering.** Three hours.  
Prerequisite: CE 340.  
Analysis and design of soil foundation systems.

**CE 551 Geometric Design of Roadways.** Three hours.  
Prerequisite: CE 350.  
Application of the principles of geometric design: alignment, vertical control, drainage, traffic control, interchanges, and intersections. Design projects will be prepared to illustrate standard techniques.

**CE 552 Traffic Safety and Security.** Three hours.  
Prerequisite: CE 350.  
Introduction to transportation safety and security issues. Site/situation identification techniques, risk assessment, countermeasure analysis, cost effectiveness, construction, and evaluation.

**CE 553 Intelligent Transportation Systems--ITS.** Three hours.  
Prerequisite: CE 350.  
Introduction to intelligent transportation systems including traffic management, institutional and planning issues; system architecture, and system design/construction/operation.

**CE 554 Urban Transportation Planning.** Three hours.  
Prerequisite: CE 350.  
An introduction to the planning process, software associated with transportation modeling, and conducting transportation planning and traffic impact studies.

**CE 556 Transportation Systems Analysis.** Three hours.  
Prerequisite: CE 350 or Graduate Status.  
Basic concepts and tools of systems analysis, including those from microeconomics, optimization, project evaluation and decision making, are integrated into the context of transportation planning and management.

**CE 560 Front End Planning.** Three hours.  
Prerequisite: CE 366  
Principles and applications for effective early planning of capital facilities, including: finance, economics decision making, risk management, team alignment, and front end planning processes and tools.

**CE 563 Construction Cost Estimating.** Three hours.  
Prerequisite: CE 366  
Addresses the estimating and cost control function from conceptual planning through project execution. Topics include productivity analysis, organization of estimates, cost forecasting, estimating tolls and techniques, contingency planning and relationship to contract types and project execution strategies.

**CE 557 Pavement Design and Construction.** Three hours.  
Prerequisite: CE 340.  
The thickness design of base, subbase, asphalt, and concrete layers for highway pavements, including both design and construction aspects.
CE 558 Traffic Engineering. Three hours.
Prerequisite: CE 350.
Vehicle operating characteristics, traffic flow, geometric design of road and intersections, and methods of traffic control.

CE 559 Pavement Rehabilitation. Three hours.
Prerequisite: CE 350.
This course covers two areas concerning care of existing highway asphalt and concrete pavements. Major maintenance includes overlay design, additional drainage, recycling, and slab repair. Routine maintenance includes distress surveys, pothole repair, and crack and joint sealing.

CE 561 Horizontal Construction Methods. Three hours.
Prerequisite: CE 366
Introduction to horizontal construction engineering equipment and methods. Design of horizontal construction systems, and construction operation analyses and simulation.

CE 562 Vertical Construction Methods. Three hours.
Prerequisite: CE 366
Construction of buildings, including mechanical, electrical plumbing and controls systems, design of temporary structures, and planning and design of lifts.

CE 564 Safety Engineering. Three hours.
Prerequisite: GES 255 or equivalent.
Not open to students with credit for CE 464. An exposure to safety engineering and accident prevention including state and federal laws related to general and construction projects. Topics include accident theories, safety regulations, Construction Safety Act, hazards and their control, human behavior and safety, and safety management.

CE 565 Advanced Blasting Engineering. Three hours.
Prerequisite: CE 340 or CE 411 or AEM 250.
Behavior of rock under dynamic loads intended to fragment or penetrate; theories of drilling, blasting, and communication; and application of theory.

CE 569 Construction Internship. Three hours.
Prerequisite: CE 366, CE464 or Graduate Standing
Practical field experience working with management of construction.

CE 570 Open Channel Flow. Three hours.
Prerequisite: CE 378.
Basic concepts of fluid flow, energy and momentum principles, flow resistance in nonuniform sections, channel controls and transitions, and nonuniform flow computations.

CE 573 Statistical Applications in Civil Engineering. Three hours.
Prerequisite: MATH 238.
Applications of statistical and probabilistic methodologies for analysis and solution of practical civil engineering problems, including frequency and risk analysis, analyses of experimental data, and systems simulation and optimization.

CE 575 Hydrology. Three hours.
Prerequisite: CE 378. Hydrologic cycle, rainfall-runoff relations, unit hydrograph, statistical hydrology, and hydrologic simulation; includes a class project with application to flood control, water supply, and multipurpose projects.
CE 580 Forensic Engineering. Three hours.  
Prerequisite: AEM 250  
When failures in the built environment occur, whether during design, construction or in-service, a thorough examination of the causes is essential to both the evolution of sound engineering practices and to dispute resolution through the legal system. The role of the engineer in this process is examined.

CE 581 Legal Aspects of Engineering and Construction. Three hours.  
Prerequisites: CE 262 and at least one CE 300-level class.  
Legal aspects of engineering and construction contacts and specifications; contract formation, interpretations, rights and duties, and changes; legal liabilities and professional ethics of architects, engineers, and contractors.

CE 582 Advanced Geological Engineering. Three hours.  
Prerequisite: GEO 101 or permission of instructor.  
Engineering properties of rocks and soils, surface and subsurface exploration, ground water, land subsidence, earthquakes, geophysical techniques, and application of geology to civil, mining, and environmental engineering.

CE 584 Experimental Design and Field Sampling. Three hours.  
Prerequisites: CE 320 & GES 255 (or equivalent) or permission of instructor  
Experimental design, sensitivity analyses, water sampling and flow monitoring. Receiving water chemical reactions. Field investigations.

CE 585 Construction Site Erosion Control. Three hours.  
Prerequisites CE 378, basic engineering hydrology.  

CE 591:592 Special Problems. One to three hours.  
Prerequisite: Written permission of the instructor.  
Independent study. Credit is based on the amount of work undertaken.

CE 598 Research Not Related to Thesis. Variable credit.

CE 599 Master's Thesis Research. One to Twelve hours.

Prerequisite: None.  
An interdisciplinary seminar that explores the impacts of homeland security on the economy, politics, law, computing infrastructure, transportation, drinking water, the environment, and other fields.

CE 622 Water Quality Engineering. Three hours.  
Prerequisites: MATH 238 and CE 424.  
Introduction to the principles of water-quality engineering and the development and use of water-quality models.

CE 629 Environmental Regulations. Three hours.  
Prerequisite: CE 424.  
Study of environmental laws and the regulations that have resulted from those laws.
CE 632 Advanced Structural Analysis II. Three hours
Prerequisite: CE 532.
Finite-element methods, three-dimensional structures.

CE 633 Structural Stability. Three hours.
Prerequisite: CE 331.
Static buckling of structural elements, frames, and trusses.

CE 634 Advanced Structural Mechanics. Three hours.
Prerequisite: CE 331 or graduate standing.
Introduction to advances structural mechanics topics, including elementary elasticity,
elementary beam theories, beams on elastic foundations, energy methods, buckling and free
vibration of beams, and elementary thin-plate theory.

CE 653 Traffic Planning. Three hours.
Prerequisite: CE 350.
The role of transportation and traffic in urban planning; the relationship of traffic facilities to
land use, zoning, and planning studies.

CE 655 Sustainable Transportation. Three hours.
Prerequisite: Instructor Permission.
Pre-requisite: Instructor permission. Course will define the concept of sustainable
transportation and examine its applications. It will address the travel behavior, land use and
policy issues that affect and are affected by the increasing emphasis towards developing more
sustainable transportation systems.

CE 656 Transportation Demand and Network Modeling. Three hours.
Prerequisite: CE456/556 or equivalent, or permission from instructor.
Co-requisite: CE 573 Statistical Application in Civil Engineering or equivalent, or consent of
instructor.
Theory and models of individual choice behavior and their applications in travel demand
modeling; mathematical models for transportation network problems and their applications in
planning and operations of urban highway and transit systems.

CE 691:692 Special Problems (Area). Variable credit.
Advanced work in some area of specialization. Credit awarded is based on the amount of work
completed.

CE 698 Research Not Related to Dissertation. Variable credit.

CE 699 Doctoral Dissertation Research. Three to twelve hours.