CIVIL ENGINEERING

- Master of Science in Civil Engineering (p. 1)

Robert Liang, Department Chairperson

Master of Science in Civil Engineering (CEE)

The program of study for the degree of Master of Science in Civil Engineering, developed in cooperation with an advisor assigned by the department chair, must include a minimum of 30 semester hours. The program of study must include:

1. Fifteen to eighteen semester hours of civil engineering, engineering mechanics, and/or thesis-related courses.
2. Six to nine semester hours of engineering or basic science electives.
3. Six semester hours of research on a civil engineering topic, CEE 599 Thesis. Students may elect to pursue a non-thesis option by replacing the six semester hours of thesis credit with six semester hours of coursework. The thesis option requires both an oral defense and a written thesis.

Students are strongly encouraged to identify an area of focus (Environmental, Geotechnical, Structural Transportation, or Water Resources) in their program of study by selecting courses from the below areas. Civil Engineering courses in addition to the offerings listed below are available.

Environmental

CEE 560	Biological Processes in Wastewater Engineering	3
CEE 562	Physical & Chemical Water & Wastewater Treatment Processes	3
CEE 563	Hazardous Waste Engineering	3
CEE 564	Solid Waste Engineering	3
CEE 574	Fundamentals of Air Pollution Engineering I	3
CEE 575	Fundamentals of Air Pollution Engineering II	3
CEE 576	Environmental Engineering Separation Processes	3

Geotechnical

CEE 520	Advanced Geotechnical Engineering	3
CEE 522	Subsurface Investigations	3
CEE 524	Foundation Engineering	3
CEE 526	Retaining Structures & Slopes	3
CEE 528	Soil Dynamics & Earthquake Engineering	3

Structural

CEE 500	Advanced Structural Analysis	3
CEE 501	Structural Analysis by Computer	3
CEE 502	Prestressed Concrete	3
CEE 503	Introduction to Continuum Mechanics	3
CEE 504	Structural Dynamics	3
CEE 505	Plastic Design in Steel	3
CEE 507	Masonry Design	3
CEE 508	Design Timber Structures	3

Engineering Mechanics

CEE 511	Experimental Stress Analysis	3
CEE 533	Theory of Elasticity	3
CEE 534	Theory of Plates & Shells	3
CEE 535	Advanced Mechanical Vibrations	3
CEE 539	Theory of Plasticity	3
CEE 540	Composites Design	3
CEE 541	Mechanics of Composite Materials	3
CEE 546	Finite Element Analysis I	3

Transportation

CEE 550	Highway Geometric Design	3
CEE 551	Traffic Engineering	3
CEE 552	Intelligent Transportation Systems	3
CEE 553	Travel Demand Modeling	3
CEE 554	Urban Public Transportation	3
CEE 555	Highway Traffic Safety	3
CEE 558	Traffic Engineering Research	3

Water Resources

CEE 580	Hydrology & Seepage	3
CEE 582	Advanced Hydraulics	3
CEE 584	Open Channel Flow	3

See also Master's Degree Requirements in School of Engineering section in the bulletin and consult with the advisor.

Courses

CEE 500. Advanced Structural Analysis. 3 Hours
Frames of variable cross section; arches; flat and folded plates; elastic stability of columns, frames, and plates; cylindrical, spherical, and barrel shells; structural dynamics of beams and frames. Prerequisite(s): CEE 317.

CEE 501. Structural Analysis by Computer. 3 Hours
Review of force and displacement methods. Introduction to direct element and substructure methods. Students write and execute computer programs to analyze plane and space trusses, grids, and frames. Prerequisite(s): CEE 317 or equivalent.

CEE 502. Prestressed Concrete. 3 Hours
Discussion of the properties of concrete and prestressed steel. Theory and design of prestressed concrete beams, slabs, columns, frames, ties, and circular tanks. Prerequisite(s): CEE 412 or equivalent.

CEE 503. Introduction to Continuum Mechanics. 3 Hours
Tensors, calculus of variations, Lagrangian and Eulerian descriptions of motion. General equations of continuum mechanics, constitutive equations of mechanics, thermodynamics of continua. Specialization to cases of solid and fluid mechanics. Prerequisite(s): EGM 303 or equivalent.

CEE 504. Structural Dynamics. 3 Hours
Response of undamped and damped single and multi-degree-of-freedom structures subjected to harmonic, periodic, and general dynamic loadings. Special topics include nonlinear structural response, response spectra, shear buildings, and simple systems with distributed properties. Prerequisite(s): CEE 316 or permission of instructor.

CEE 505. Plastic Design in Steel. 3 Hours
Analysis and design procedures based on ultimate load capacity applied to steel beams, frames, and their connections. Concept of plastic hinge, necessary conditions for the existence of plastic moment, instability, deformations, repeated and reversed loading, and minimum weight design. Prerequisite(s): CEE 411 or equivalent.

CEE 507. Masonry Design. 3 Hours
Properties and performance criteria of bricks, concrete blocks, mortar and grout; codes and construction practices; design of masonry elements. Prerequisite(s): CEE 316.

CEE 508. Design Timber Structures. 3 Hours
Study of basic wood properties and design considerations. Design and behavior of wood connectors, fasteners, beams, columns, and beam columns. Introduction to plywood and glued laminated members. Analysis and design of structural diaphragms and shear walls. Prerequisite(s): CEE 316 or permission of instructor.

CEE 511. Experimental Stress Analysis. 3 Hours
A study of the experimental analysis of stress as an aid to design for strength and economy with emphasis on electrical strain gages. Also, photoelasticity, brittle coatings, analogies, structural similitude. Two hours lecture and one three-hour laboratory period per week. Prerequisite(s): EGM 303 or equivalent.

CEE 515. Pavement Engineering. 3 Hours
Fundamental principles of flexible and rigid highway and airport pavement design, construction, and management. Prerequisite(s): CEE 403 or consent or equivalent.

CEE 520. Advanced Geotechnical Engineering. 3 Hours
Advanced study of Geotechnical engineering principles and study. Stress-strain characteristics; constitutive relationships; failure theories; dynamic soil properties; difficult soils; soil improvement; stability of earth slopes. Prerequisite(s): CEE 312 or equivalent.

CEE 522. Subsurface Investigations. 3 Hours
Soil & rock classification; Geophysical methods; subsurface explorations; soil sampling; van shear, standard penetration, cone penetration, pressuremeter, dilatometer, and plate load testing; in-situ measurements; field instrumentation. Prerequisite(s): CEE 312 or equivalent.

CEE 524. Foundation Engineering. 3 Hours
Application of Geotechnical engineering principles of analysis and design of shallow and deep foundations and earth retaining structures. Topics include site exploration and characterization, foundation types, bearing capacity, settlement analysis, shallow foundation design, earth pressures theories, design of retaining walls, flexible retaining structures and braced excavations, design of pile foundations and drilled piers. Prerequisite(s): CEE 312 or equivalent.

CEE 526. Retaining Structures & Slopes. 3 Hours
Earth pressure theories; design of earth retaining structures, such as rigid walls, anchored sheet pile walls, and reinforced soil structures; stability of excavation, cut, and natural slopes; slope stabilization methods. Prerequisite(s): CEE 312 or equivalent.

CEE 528. Soil Dynamics & Earthquake Engineering. 3 Hours
Soil behavior under dynamic loading conditions; foundation design for vibratory loadings; introductory earthquake engineering; field and laboratory techniques for determining dynamic soil properties and liquefaction potential. Prerequisite(s): CEE 312 or equivalent.

CEE 533. Theory of Elasticity. 3 Hours
Three-dimensional stress and strain at a point; equations of elasticity in Cartesian and curvilinear coordinates; methods of formulation of equations for solution, plane stress and plane strain, energy formulations, numerical solution procedures. Prerequisite(s): EGM 303 or equivalent. Corequisite(s): EGM 503.

CEE 534. Theory of Plates & Shells. 3 Hours
Theory of plates; small and large displacement theories of thin plates; shear deformation; buckling; sandwich plate theory. Thin shell theory; theory of surfaces; thin shell equations in orthogonal curvilinear coordinates; bending, membrane, and shallow shell theories. Prerequisite(s): EGM 533.

CEE 535. Advanced Mechanical Vibrations. 3 Hours
Review of undamped, damped, natural, and forced vibrations of one and two degrees of freedom systems. Lagrange's equation, eigenvalue/eigenvector problem, modal analysis for discrete and continuous systems. Computer application for multi-degree of freedom, nonlinear problems. Prerequisite(s): MEE 319 or equivalent; computer programming.

CEE 539. Theory of Plasticity. 3 Hours
Fundamentals of plasticity theory including elastic, viscoelastic, and elastic-plastic constitutive models; plastic deformation on the macroscopic and microscopic levels; stress-strain relations in the plastic regime; strain hardening; limit analysis; numerical procedures. Prerequisite(s): EGM 503 or EGM 533.

CEE 540. Composites Design. 3 Hours
Design with fiber reinforced composite materials. Fiber and resin selection, laminate design, bending and torsion of stiffening elements, open and filled holes, joining methods, fatigue, damage tolerance, building block approach, design allowables. Prerequisite(s): EGM 303 or equivalent.

CEE 541. Mechanics of Composite Materials. 3 Hours
Introduction to the mechanical response of fiber-reinforced composite materials with emphasis on the development of experimental methodology. Analytical topics include stress-strain behavior of anisotropic materials, laminate mechanics, and strength analysis. Theoretical models are applied to the analysis of experimental techniques used for characterizing composite materials. Lectures are supplemented by laboratory sessions in which characterization tests are performed on contemporary composite materials. Prerequisite(s): EGM 303 or equivalent.

CEE 543. Analytical Mechanics Composite Materials. 3 Hours
Analytical models are developed for predicting the mechanical and thermal behavior of fiber-reinforced composite materials as a function of constituent material properties. Both continuous and discontinuous fiber-reinforced systems are considered. Specific topics include basic mechanics of anisotropic materials, micro-mechanics and lamination theory, free edge effects, and failure criteria. Prerequisite(s): EGM 303 or equivalent.

CEE 546. Finite Element Analysis I. 3 Hours
Fundamental development of the Finite Element Method (FEM), and solution of field problems and comprehensive structural problems. Variational principles and weak, forms; finite element discretization; shape functions; finite elements for field problems; bar, beam, plate, and shell elements; isoparametric finite elements, stiffness, nodal force, and mass matrices; matrix assembly procedures; computer coding techniques; modeling decisions; program output interpretation. Emphasis on a thorough understanding of FEM theory and modeling techniques. Prerequisite(s): CEE 503 or CEE 533.

CEE 550. Highway Geometric Design. 3 Hours
Advanced topics in horizontal and vertical alignment design controls and criteria, sight distance, intersection and interchange design. Prerequisite(s): CEE 403 or equivalent.

CEE 551. Traffic Engineering. 3 Hours
Characteristics of traffic, including the road user, vehicle, traffic control devices, accident analysis, signal operations and design and the fundamentals of signal system progression. Prerequisite(s): CEE 403 or equivalent.

CEE 552. Intelligent Transportation Systems. 3 Hours
Fundamentals of planning, design, deployment and operations of ITS. Integrated application of ITS architecture, traffic flow principles, advanced equipment, communications technologies and management strategies to provide traveler information and increase the safety and efficiency of the surface transportation system. Prerequisite(s): CEE 403 or equivalent.

CEE 553. Travel Demand Modeling. 3 Hours
Introduction to the theory, concepts and methods underlying the practice of urban travel demand modeling. The course involves model data inputs, model development, forecasting applications, and model evaluation techniques. Prerequisite(s): CEE 403 or equivalent.

CEE 554. Urban Public Transportation. 3 Hours
Planning and analysis of urban public transportation service and operations with a focus on bus and rail modes. Provides fundamental knowledge and methods for route and network planning, service planning and analysis, performance monitoring, operations control, and frequency and headway determination. Prerequisite(s): CEE 403 or equivalent.

CEE 555. Highway Traffic Safety. 3 Hours
Issues involved in transportation safety, strategic highway safety planning at state and local levels. Extent of the highway safety problem, elements of traffic accidents, common accident countermeasures, collection and analysis of accident data, evaluation of safety-related projects and programs, and litigation issues. Prerequisite(s): CEE 403 or equivalent.

CEE 558. Traffic Engineering Research. 3 Hours
Practical problems in control or capacity restraints based on studies of actual local situations. Prerequisite(s): CEE 403 or equivalent.

CEE 560. Biological Processes in Wastewater Engineering. 3 Hours
Measuring the characteristics of wastewater produced from domestic and industrial sources. Principles of designing and operating microbiological processes for the treatment of wastewater. Mechanisms and kinetics of biological reactions emphasized. Prerequisite(s): CHM 124 and (CEE 434 or CME 406) or equivalent.

CEE 562. Physical & Chemical Water & Wastewater Treatment Processes. 3 Hours
Principles and design of physical and chemical unit processes to treat water and wastewater. Industry pretreatment technologies and the basis for their development. Prerequisite(s): CHM 124 and (CEE 434 or CME 406) or equivalent.

CEE 563. Hazardous Waste Engineering. 3 Hours
The fundamental principles of the design and operation of hazardous waste control and hazardous substances remediation processes. Hazardous waste regulations, risk assessment and management. Prerequisite(s): CHM 124 or equivalent.

CEE 564. Solid Waste Engineering. 3 Hours
Characterizing solid waste. Managing solid waste collection, transport, minimization, and recycling. The design of solid waste disposal and resource recovery facilities.

CEE 574. Fundamentals of Air Pollution Engineering I. 3 Hours
Air pollution, combustion fundamentals, pollutant formation and control in combustion, pollutant formation and control methods in internal combustion engines, particle formation in combustion. Prerequisite(s): ((CME 311 or MEE 301); (CME 324 or MEE 410)) or permission of instructor.

CEE 575. Fundamentals of Air Pollution Engineering II. 3 Hours
Review of the concepts of air pollution engineering; aerosols; removal of gaseous pollutants from effluent streams; optimal air pollution control strategies. Prerequisite(s): CME 574 or permission of instructor.

CEE 576. Environmental Engineering Separation Processes. 3 Hours
Discussion of the unit operations associated with environmental engineering separation processes of solid-liquid, liquid-liquid, and gas-liquid systems; general use, principles of operation, and design procedures for specific types of equipment. Prerequisite(s): Permission of instructor.

CEE 580. Hydrology & Seepage. 3 Hours
Detailed study of the hydrologic cycle with a focus on rainfall/runoff generation techniques. Practical application of hydrologic fundamentals is demonstrated through the design of urban storm water systems. Introduction to sub-surface hydrology and groundwater modeling. Prerequisite(s): CEE 312, CEE 333 or equivalent.

CEE 582. Advanced Hydraulics. 3 Hours
Detailed examination of unsteady flow in closed-conduits and open channels. Practical methods for solving waterhammer and flood routing problems are presented. Physical modeling integrated with dimensional analysis and similitude is presented. Prerequisite(s): CEE 313, CEE 333 or equivalent.

CEE 584. Open Channel Flow. 3 Hours
Open channel flow in its various forms will be studied. Major topics to be covered include energy and momentum principles, uniform and gradually varied flow, rapidly varied flow, spatially varied flow and an introduction to unsteady flow. Pragmatic applications such as channel design, water surface profile computations, and culvert analysis will also be covered. Well-established solution approaches and widely accepted computer methods will be used to solve real-world problems. Prerequisite(s): CEE 313, CEE 333 or equivalent.

CEE 590. Selected Readings in Civil Engineering. 3 Hours
Directed readings in a designated area arranged and approved by the student's faculty advisor and the department chair. May be repeated.

CEE 595. Special Problems in Civil Engineering. 3 Hours
Special assignments in civil engineering subject matter to be arranged and approved by the student's advisor and the department chair.

CEE 598. Project. 3 Hours
Project in Civil and Environmental Engineering.

CEE 599. Thesis. 3-6 Hours
Thesis in Civil and Environmental Engineering.