Civil Engineering (CE) Courses

**CE 5001. Process and Ethics in Thesis/Dissertation Research Development. (1-0) 1 Credit Hour.**
Course discusses the process and the ethical issues involved in conducting research and developing a thesis or dissertation. It covers research organizational skills, literature searches, technical writing, honesty in writing and plagiarism issues.

**CE 5013. Civil Engineering Systems Analysis. (3-0) 3 Credit Hours.**
Systems approach to optimization and problem solving; operations research applications in civil engineering; mathematical modeling and analysis techniques including linear programming, dynamic programming, decision analysis and use of software to solve linear and nonlinear programming problems.

**CE 5023. Finite Element Methods. (3-0) 3 Credit Hours.**
Derivation and computer implementation of the finite element method for the solution of civil engineering boundary value problems. (Same as ME 5483. Credit cannot be earned for both CE 5023 and ME 5483).

**CE 5043. Advanced Civil Engineering Statistics. (3-0) 3 Credit Hours.**
Statistical analysis methods include descriptive statistics, interval estimation and hypothesis testing, analysis of variance, design of experiments, regression analysis, and time series analysis. Additional topics covered include probabilistic methods, decision analysis and reliability analysis applied to civil engineering systems.

**CE 5103. Advanced Steel Design. (3-0) 3 Credit Hours.**
Connection design, welded and bolted, moment-resistant connections, plate girders, column stability, bracing design, and seismic design of frames. (Formerly CE 5343 Topic 4: Advanced Steel Design. Credit cannot be earned for both CE 5103 and CE 5343 Advanced Steel Design).

**CE 5123. Bridge Engineering. (3-0) 3 Credit Hours.**
Design loads, load distribution, design of superstructures and substructures, and evaluation and load rating capacity of bridges. (Former CE 5343 Topic 8: Bridge Engineering. Credit cannot be earned for both CE 5123 and CE 5343 Bridge Engineering).

**CE 5133. Advanced Reinforced Concrete. (3-0) 3 Credit Hours.**
Curved beams, torsion design, retaining walls and shear walls, stairs, two-way slabs, yield-line theory, biaxial load on columns, slenderness effects, joint design, strut-and-tie methods, and concrete elasticity and failure criteria. (Formerly CE 5343 Topic 2: Advanced Reinforced Concrete Structures. Credit cannot be earned for both CE 5133 and CE 5343 Advanced Reinforced Concrete Structures).

**CE 5143. Numerical Methods in Civil Engineering. (3-0) 3 Credit Hours.**
Mathematical equation root finding and optimization methods, matrix equations, solution methods, eigenvector and eigenvalue solution methods, finite difference methods, curve-fitting methods, numerical integration and differentiation techniques, and introduction to finite element formulations.

**CE 5153. Prestressed Concrete. (3-0) 3 Credit Hours.**
Overview of prestressed concrete development; design properties of materials; analysis and design of pre-tensioned and post-tensioned concrete members; full and partial prestressing; serviceability and strength requirements, code criteria for prestressed continuous beams, statically indeterminate frames and other structures. (Formerly CE 5343 Topic 3: Prestressed Concrete. Credit cannot be earned for both CE 5153 and CE 5343 Prestressed Concrete).

**CE 5203. Environmental Microbiology. (3-0) 3 Credit Hours.**
To provide a basic understanding of environmental microbiology primarily from two aspects: microbial interactions with chemical pollutants in the environment and the fate of microbial pathogens in the environment. Topics covered include microbial environments, detection of bacteria and their activities in the environment, microbial biogeochemistry, bioremediation and water quality. (Same as ES 5063. Credit cannot be earned for both CE 5203 and ES 5063).

**CE 5213. Biological Phenomena in Environmental Engineering. (3-0) 3 Credit Hours.**
The major biological phenomena and processes used in environmental engineering control. Fundamentals of microbiology and biochemistry as applied to wastewater treatment, drinking water treatment, and hazardous waste remediation. (Formerly titled "Industrial Waste Treatment").

**CE 5293. Geographic Information Systems (GIS). (3-0) 3 Credit Hours.**
Introduces vector, raster and tabular concepts, emphasizing the vector approach. Topics include spatial relationships, map features, attributes, relational database, layers of data, data ingesting, digitizing from maps, projections, output, applications, and availability of public data sets. Focus will be placed on spatial/temporal data analyses using digitized maps and database information in an area of CE specialization.

**CE 5303. Hydrometeorology. (3-0) 3 Credit Hours.**
The main objective of this course is to familiarize the student with the local and global distribution of freshwater. Conceptualizations of the water balance/budget are developed using principles of physical hydrology and meteorology. Emphasis will be on recent research and modern methods for data analysis and modeling. Real life events and phenomena will be discussed. In addition to the text, material will be presented from other sources. Guest instructors will give presentations on some case studies.

**CE 5343. Advanced Characterization of Highway Materials. (3-0) 3 Credit Hours.**
Basic and advanced level of the fundamentals of material response to static and repeated loading; emphasis on the deformation and fatigue behavior of asphalt mixtures, constitutive modeling for mixtures, microstructure characterization for mixtures, nondestructive testing of pavements, asphalt binder characterization, unbound materials (base and sub-base materials) evaluation and characterization.

**CE 5423. Advanced Pavement Analysis and Design. (3-0) 3 Credit Hours.**
CE 5433. Advanced Geometric Design. (3-0) 3 Credit Hours.
Course deals with the geometric design of highways and streets. Topics include highway functions, design controls and criteria, elements of design, local roads and streets, freeways, and intersections. (Formerly CE 5513 Topic 6: Advanced Geometric Design. Credit cannot be earned for both CE 5433 and CE 5513 Advanced Geometric Design).

CE 5443. Pavement Management. (3-0) 3 Credit Hours.
Pavement evaluation and performance, evaluation of pavement distress condition surveys, evaluation of pavement roughness ride quality, skid resistance of pavements, evaluation of pavement structural capacity, maintenance and rehabilitation, prioritization and optimization of pavement maintenance, and rehabilitation needs. (Formerly CE 5513 Topic 4: Pavement Management Systems. Credit cannot be earned for both CE 5443 and CE 5513 Pavement Management Systems).

CE 5453. Transportation Engineering. (3-0) 3 Credit Hours.
Study of the Highway Capacity Manual, traffic stream parameters and relationships, analytical techniques in traffic engineering such as capacity analysis, queuing theory, and traffic simulation. Design and operation of advanced traffic management systems including signalization, real-time motorist information, urban incident management, and ITS concepts. (Formerly CE 5513 Topic 8: Principles of Traffic Engineering. Credit cannot be earned for both CE 5453 and CE 5513 Principles of Traffic Engineering).

CE 5463. Foundation Engineering. (3-0) 3 Credit Hours.
Shallow and deep foundations, including footings, slabs on-grade, piers and columns, gravity and diaphragm walls, drilled shafts, piles and retaining walls. (Formerly CE 5533 Topic 2: Advanced Foundation Engineering. Credit cannot be earned for both CE 5463 and CE 5533 Advanced Foundation Engineering).

CE 5513. Environmental Chemistry. (3-0) 3 Credit Hours.
This course explores the chemistry of the environment, the chemistry underlying environmental problems and solutions to environmental problems. Emphasis is placed on thermodynamics and kinetics of reaction cycles; sources, sinks and transport of chemical species; and quantitation of chemical species. Examples are selected from the chemistry of natural and contaminated air, water, and soil.

CE 5523. Advanced Treatment Processes for Water Quality Control. (3-0) 3 Credit Hours.
Principles, modeling and design aspects of physical chemical treatment processes in drinking water, wastewater and groundwater remediation applications. (Formerly CE 5233 Topic 1: Physical and Chemical Treatment Operations. Credit cannot be earned for both CE 5523 and CE 5523 Physical and Chemical Treatment Operations).

CE 5543. Sustainable Energy Systems. (3-0) 3 Credit Hours.
Course explores various facets of sustainable energy systems and their role in securing America’s energy future. It covers national and global energy trends, social, political, regulatory, technical/economic constraints and policy considerations. The course uses a systems approach in examining the technology and economics behind each alternative energy source and the major qualitative and quantitative factors affecting their large-scale deployment. (Same as ME 5273. Credit cannot be earned for both CE 5543 and ME 5273).

CE 5563. River Science. (3-0) 3 Credit Hours.
An in-depth examination of river sediment transport principles. Topics include water and sediment supply, sediment dynamics, river morphology, and channel instability. Field trip required. (Same as GEO 5413. Credit cannot be earned for both CE 5563 and GEO 5413).

CE 5663. River Mechanics and Engineering Applications. (3-0) 3 Credit Hours.
Prerequisite: CE 5653 or equivalent. This course focuses on the application of sediment transport principles to practical river mechanics and environmental problems. Applications include laboratory experiments, and numerical simulations related to the solution of practical river engineering problems.

CE 5703. Special Topics in Hydraulics and Hydrology. (3-0) 3 Credit Hours.
Course deals with special aspects of hydraulics and hydrology. May be repeated for credit as topics vary.

CE 5713. Special Topics in Structures. (3-0) 3 Credit Hours.
Course deals with special aspects of structural engineering. May be repeated for credit as topics vary.

CE 5733. Special Topics in Environmental Engineering. (3-0) 3 Credit Hours.
Course deals with special aspects of environmental engineering. May be repeated for credit as topics vary.

CE 5973. Special Project. (0-0) 3 Credit Hours.
Work carried out by nonthesis Master’s students under the direction of their Advisory Committee to fulfill the project requirement of their degree. It may involve applied or theoretical work and a report documenting the findings.

CE 5981. Master’s Thesis. (0-0) 1 Credit Hour.
Prerequisite: Approval of the student’s Advisory Committee. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master’s degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. (Formerly CE 6983).

CE 5982. Master’s Thesis. (0-0) 2 Credit Hours.
Prerequisite: Approval of the student’s Advisory Committee. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master’s degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. (Formerly CE 6983).

CE 5983. Master’s Thesis. (0-0) 3 Credit Hours.
Prerequisite: Approval of the student’s Advisory Committee. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master’s degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. (Formerly CE 6983).

CE 5991. Graduate Seminar. (1-0) 1 Credit Hour.
Graduate seminar may be repeated for credit up to 3 semester credit hours.

CE 6013. Hydrologic Modeling and Analysis. (3-0) 3 Credit Hours.
This course will address hydrological modeling (both theory and practical applications with focus on the latter) and related issues. Multimedia and advanced visualization will be used in lectures and class work. Most of the course is dedicated to hands-on, problem-oriented applications using a variety of practical techniques. It will provide students with the knowledge and tools necessary to use data derived from geographical information systems (GIS) to develop hydrologic estimates needed for different applications.
CE 6103. Fate and Transport of Contaminants in the Environment. (3-0) 3 Credit Hours.
The course deals with the hydrodynamics of mixing and transport, as well as the interaction of mixing and various reaction rate processes. Applications in the course will include water and wastewater treatment, groundwater pollution, and transport and mixing in rivers, lakes and reservoirs. (Formerly CE 6053 Topic 1: Fate and Transport of Contaminants in Environmental System. Credit cannot be earned for both CE 6103 and CE 6053 Fate and Transport of Contaminants in Environmental System).

CE 6113. Global Change. (3-0) 3 Credit Hours.
Changes in the global distribution of plants and animals and the causes of the changes will be examined. Factors that are apparently coupled to changes in the atmosphere and environmental temperature will be examined. (Same as ES 5043 and GEO 5043. Credit can be earned for only one of the following: CE 6113, ES 5043, or GEO 5043).

CE 6221. Graduate Seminar in Environmental Science and Engineering. (1-0) 1 Credit Hour.
Will include presentations of current research by faculty and invited guests who are experts in various aspects of research in the environmental sciences and engineering, and advanced graduate students who are about to complete their dissertation research. May be repeated for credit.

CE 6523. Advanced Surface Water Hydrology. (3-0) 3 Credit Hours.
Use of state-of-the-art computer models to study the rainfall-runoff process. Extreme events are the focus of the course (droughts and floods). Approaches to developing design precipitation events will also be presented. (Formerly CE 5313 Topic 3: Advanced Surface Water Hydrology. Credit cannot be earned for both CE 6523 and CE 5313 Advanced Surface Water Hydrology).

CE 6951. Independent Study. (0-0) 1 Credit Hour.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6952. Independent Study. (0-0) 2 Credit Hours.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6953. Independent Study. (0-0) 3 Credit Hours.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6954. Independent Study. (0-0) 4 Credit Hours.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6955. Independent Study. (0-0) 5 Credit Hours.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6956. Independent Study. (0-0) 6 Credit Hours.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6957. Independent Study. (0-0) 7 Credit Hours.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6958. Independent Study. (0-0) 8 Credit Hours.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6959. Independent Study. (0-0) 9 Credit Hours.
Prerequisites: Written permission of the instructor and the student’s Advisory Committee. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master’s degree.

CE 6961. Comprehensive Examination. (0-0) 1 Credit Hour.
Prerequisite: Written permission of the student’s Advisory Committee. The comprehensive examination course is intended as a 1 semester credit hour substitute for the Master of Science degree in Civil Engineering thesis or the Master of Civil Engineering graduate seminar. Students may register for this course in a semester in which the examination is to be taken, if they are not enrolled in other courses. The grade report for the course is either “CR” (satisfactory performance on the Comprehensive Examination) or “NC” (unsatisfactory performance on the Comprehensive Examination).

CE 7211. Doctoral Research. (0-0) 1 Credit Hour.
Prerequisites: Admission to Doctoral candidacy, consent of the student’s Dissertation Committee and consent of the DSC. Research work carried out by the student under the supervision of their Dissertation Committee. May be repeated as necessary, but no more than 15 hours may be applied to the Doctoral degree.

CE 7212. Doctoral Research. (0-0) 2 Credit Hours.
Prerequisites: Admission to Doctoral candidacy, consent of the student’s Dissertation Committee and consent of the DSC. Research work carried out by the student under the supervision of their Dissertation Committee. May be repeated as necessary, but no more than 15 hours may be applied to the Doctoral degree.

CE 7213. Doctoral Research. (0-0) 3 Credit Hours.
Prerequisites: Admission to Doctoral candidacy, consent of the student’s Dissertation Committee and consent of the DSC. Research work carried out by the student under the supervision of their Dissertation Committee. May be repeated as necessary, but no more than 15 hours may be applied to the Doctoral degree.

CE 7311. Doctoral Dissertation. (0-0) 1 Credit Hour.
Prerequisites: Successful defense of the oral defense, consent of the student’s Dissertation Committee and consent of the DSC. Dissertation work carried out by the student under the supervision of their Dissertation Committee. May be repeated as necessary, but not more than 15 hours may be applied to the Doctoral degree.

CE 7312. Doctoral Dissertation. (0-0) 2 Credit Hours.
Prerequisites: Successful defense of the oral defense, consent of the student’s Dissertation Committee and consent of the DSC. Dissertation work carried out by the student under the supervision of their Dissertation Committee. May be repeated as necessary, but not more than 15 hours may be applied to the Doctoral degree.

CE 7313. Doctoral Dissertation. (0-0) 3 Credit Hours.
Prerequisites: Successful defense of the oral defense, consent of the student’s Dissertation Committee and consent of the DSC. Dissertation work carried out by the student under the supervision of their Dissertation Committee. May be repeated as necessary, but not more than 15 hours may be applied to the Doctoral degree.