Civil Engineering - Course Descriptions

**CE 101 Engineering Surveying 0R-6L2C F**
Prerequisites: There are no prerequisites for this course.
Corequisites: There are no corequisites for this course.
Covers basic principles and practices of surveying. Measurement through the application of surveying techniques; theory of errors and their analysis; concepts of horizontal, vertical, and angular measurement; coordinate systems; basic surveying operations and computations; reading and interpretation of building, highway, and/or bridge plans; traverse computations; applications to construction and design.

**CE 111 Geographical Information Systems 2R-0L-2C W**
Prerequisites: There are no prerequisites for this course.
Corequisites: There are no corequisites for this course.
The course covers introductory concepts of geographical information systems and related technologies. Topics covered will relate to the use, collection, creation, and analysis of spatial data in applying GIS and related technologies to civil engineering projects.

**CE 205 Thermodynamics 4R-0L-4C F**
Prerequisites: MA 112 Calculus II 5R-0L-5C F,W,S
Corequisites: There are no corequisites for this course.
Covers first law of thermodynamics, second law of thermodynamics, concept of entropy, simple process analysis, properties of pure substances, equations of state, and state diagrams. Stresses use of property tables and charts and application of the first and the second laws to open and closed systems undergoing changes.

**CE 250 Sustainable Civil Engineering Design 2R-0L-2C W**
Prerequisites: EM 103 Introduction to Design 1R-3L-2C S
Corequisites: There are no corequisites for this course.
An introduction to sustainable design of civil engineering systems. Includes treatment of current issues as they relate to design and construction for economic, environmental and social aspects of civil engineering.

**CE 303 Engineering Economy 4R-0L-4C W**
Prerequisites: There are no prerequisites for this course.
Corequisites: There are no corequisites for this course.
Emphasizes time value of money and factors related thereto. Familiarizes students with concepts of annual cost, present worth, and minimum rate of return as tools for consideration of economic factors pertinent to the selection of alternate solutions to engineering problems.

**CE 310 Computer Applications in Civil Engineering 2R-0L-2C S**
Prerequisites: CE 371 Hydraulic Engineering 3R-3L-4C F, and CE 432 Structural Design in Concrete I 3R-0L-3C W
Corequisites: There are no corequisites for this course.
Students develop solutions to a variety of civil engineering problems using application programs such as Mathcad, Excel, and Matlab. Emphasis is made on problem solving approach and structured programming with software tools useful to civil engineering computation and design.

**CE 320 Civil Engineering Materials 3R-3L-4C S**

**Prerequisites:** There are no prerequisites for this course.

**Corequisites:** There are no corequisites for this course.

A study of the origin, nature, performance and selection criteria of various basic materials used in the practice of civil engineering. These include aggregates, portland cement, concrete, and bituminous materials. Emphasis will be placed on standard methods of testing and characterization as related to the mechanical behavior of materials.

**CE 321 Structural Mechanics I 4R-0L-4C F**

**Prerequisites:** EM 203 Mechanics of Materials 4R-0L-4C F, W

**Corequisites:** There are no corequisites for this course.

Classical structural analysis. Idealizations, stability, reactions and internal forces, influence lines, approximate analysis, and displacements.

**CE 336 Soil Mechanics 3R-3L-4C F**

**Prerequisites:** EM 203 Mechanics of Materials 4R-0L-4C F, W, and EM 301 Fluid Mechanics 4R-0L-4C S

**Corequisites:** There are no corequisites for this course.

Introduces the student to the fundamental concepts of soil mechanics. Covers types and properties of soils, lateral and vertical pressures, settlement and consolidation, strength and seepage studies. Includes laboratory investigation of soil properties.

**CE 371 Hydraulic Engineering 3R-3L-4C F**

**Prerequisites:** EM 301 Fluid Mechanics 4R-0L-4C S or equivalent

**Corequisites:** There are no corequisites for this course.

Application of basic fluid mechanics principles to the fields of hydraulics and water resources. Topics covered include: open channel flow, closed conduit flow, flow measurement, and turbomachinery. Stresses practical applications in the laboratory.

**CE 380 Introduction to Transportation Engineering 4R-0L-4C S**

**Prerequisites:** There are no prerequisites for this course.

**Corequisites:** MA 223 Engineering Statistics I 4R-0L-4C F,W,S, and CE 320 Civil Engineering Materials 3R-3L-4C S

Study of transportation functions and transportation systems; measuring and estimating demand; characteristics of transportation modes, interactions between modes, and mode interfaces; social, environmental, technological, economic, and public policy impacts; techniques of transportation system planning, design, and operation, with an emphasis on highway geometric design.

**CE 400 Career Preparation Seminar 1R-0L-0C S**

**Prerequisites:** CE 468 Civil Engineering Design & Synthesis II 1R-2L- 2C W

**Corequisites:** There are no corequisites for this course.

Preparation for the student to become a practicing engineer. Topics include Civil Engineering job expectations, continuing education, legal considerations, professionalism, consumer topics, and financial considerations.
CE 420 Consulting Engineering Seminar 2R-0L-2C S
Prerequisites: Junior class standing
Corequisites: There are no corequisites for this course.
Discusses problems in the field of consulting engineering; includes seminars presented by practicing consulting engineers and a suitable project to practice consulting skills. Cross-listed with BE 400, CHE 420, ECE 466, and ME 420.

CE 421 Structural Mechanics II 4R-0L-4C W
Prerequisites: CE 321 Structural Mechanics I 4R-0L-4C F
Corequisites: There are no corequisites for this course.
Hand methods for structural analysis of indeterminate structures: approximating drift of frames and solid walls, force method, moment distribution method, distribution of shear when there is a rigid diaphragm, and in-plane diaphragm forces.

CE 431 Structural Design in Steel I 3R-0L-3C S
Prerequisites: CE 321 Structural Mechanics I 4R-0L-4C F
Corequisites: There are no corequisites for this course.
Covers the analysis and design of the basic elements of a steel structure using Load and Resistance Factor Design specifications. Includes tension and compression members, beams, beam-columns and connections.

CE 432 Structural Design in Concrete I 3R-0L-3C W
Prerequisites: CE 321 Structural Mechanics I 4R-0L-4C F
Corequisites: There are no corequisites for this course.
Deals with the analysis and design of reinforced concrete beams, floor slabs, and columns using the Ultimate Strength Design procedure.

CE 436 Foundation Engineering 4R-0L-4C F
Prerequisites: CE 336 Soil Mechanics 3R-3L-4C F, and CE 432 Structural Design in Concrete I 3R-0L-3C W
Corequisites: There are no corequisites for this course.
Covers the application of soil mechanics principles to foundation problems. Includes design of building foundations and retaining walls, stability analysis of open cuts and slopes, dewatering methods, and a study of the influence of local geology.

CE 441 Construction Engineering 2R-0L-2C W
Prerequisites: Junior class standing or consent of instructor
Corequisites: There are no corequisites for this course.
Covers planning and scheduling techniques for construction engineering: Gantt charts, critical path method, precedence diagramming method, activity on arrow and PERT methods, resource allocation, and time-cost tradeoffs.

CE 442 Cost Engineering 4R-0L-4C W
Prerequisites: Senior class standing
Corequisites: There are no corequisites for this course.
An investigation of some of the cost accounting, cost management and estimating techniques which are used in the construction industry. Various types of estimates will be considered, as well as their multiple applications for project management. Special attention will be given to the preparation of detailed estimates based on quantity take-offs and to analyses of production productivity.

CE 445 Construction Methods & Equipment 4R-0L-4C F
Prerequisites: Senior class standing or consent of instructor
Corequisites: There are no corequisites for this course.
A study of economics, fundamental concepts and functional applications of major categories of construction equipment. Operational characteristics, capability and applicability of equipment to heavy, highway and major building construction projects.

CE 450 Civil Engineering Codes & Regulations 4R-0L-4C F
Prerequisites: CE 321 Structural Mechanics I 4R-0L-4C F, and CE 471 Water Resources Engineering 4R-0L-4C W
Corequisites: There are no corequisites for this course.
Examination of typical codes and regulations in the civil engineering profession. Local, state, and national building codes; Americans with Disabilities Act (ADA); zoning regulations; etc. Will look at major environmental regulations and sustainability assessment tools. Includes major building code evaluation and site development exercises.

CE 460 Introduction to Environmental Engineering 4R-0L-4C S
Prerequisites: EM 301 Fluid Mechanics 4R-0L-4C S or CHE 301 Fluid Mechanics 4R-0L-4C F,S or ES 202 Fluid Systems 2 2/3R-1L-3C F,S
Corequisites: There are no corequisites for this course.
Introduction to water pollution control, air pollution control, and solid and hazardous waste management. Topics include water treatment, wastewater treatment, impacts of pollutants on lakes and streams, and stream and air quality modeling.

CE 461 Environmental Engineering laboratory 1R-3L-2C S
Prerequisites: There are no prerequisites for this course.
Corequisites: CE 460 Introduction to Environmental Engineering 4R-0L-4C S
Emphasizes laboratory methods and interpretation of laboratory results for chemical analysis of water and wastewater.

CE 463 Unit Operations in Environmental Engineering 4R-0L-4C F
Prerequisites: CE 460 Introduction to Environmental Engineering 4R-0L-4C S
Corequisites: There are no corequisites for this course.
Covers the physical, chemical, and biological operations and processes of interest to water and wastewater treatment systems. Topics include sedimentation, mixing, activated sludge coagulation, flocculation, granular filtration and adsorption. Cross-listed with CHE461.

CE 471 Water Resources Engineering 4R-0L-4C W
Prerequisites: EM 301 Fluid Mechanics 4R-0L-4C S or CHE 301 Fluid Mechanics 4R-0L-4C F,S or ES 202 Fluid Systems 2 2/3R-1L-3C F,S
Corequisites: There are no corequisites for this course.
Presents an overview of the engineering, planning, design, and operation of various water resources projects. Topics include surface and groundwater hydrology, sanitary and storm sewer design, dams and reservoirs, water law, wetlands, and nonpoint source pollution.

CE 480 Geometric Design of Highways and Streets 4R-0L-4C W
Prerequisites: CE 101 Engineering Surveying 0R-6L2C F, and CE 380 Introduction to Transportation Engineering 4R-0L-4C S
Corequisites: There are no corequisites for this course.
Highway planning and design with evaluation of multiple alignment alternatives; geometric design of highways: horizontal and vertical alignment, cross-sectional design; intersection design; earthwork measurements and quantities; reverse curve design; legal aspects of transportation engineering; proper use of the American Association of State Highway and Transportation Officials (AASHTO) design guidelines.

**CE 481 Traffic Analysis & Design 4R-0L-4C F**
**Prerequisites:** CE 380 Introduction to Transportation Engineering 4R-0L-4C S
**Corequisites:** There are no corequisites for this course.
Study of fundamentals of traffic engineering; components of the traffic system; intersection types and design elements; basic variables of the traffic system (flow, capacity, level of service, delay); design and analysis of traffic signals and intersections; traffic control and traffic impact analysis; safety performance and traffic crash analysis; use of the Highway Capacity Manual and traffic analysis software.

**CE 482 Urban Transportation Planning 4R-0L-4C F or W**
**Prerequisites:** CE 380 Introduction to Transportation Engineering 4R-0L-4C S
**Corequisites:** There are no corequisites for this course.
Applies general principles of planning, evaluation, selection, adoption, financing, and implementation of alternative urban transportation systems to urban and regional planning; formulation of community goals and objectives, inventory of existing conditions; transportation modeling—trip generation, distribution, modal choice, assignment, technological characteristics and operation of modern transit and other movement systems.

**CE 483 Railroad Engineering 4R-0L-4C S**
**Prerequisites:** Junior standing or consent of instructor
**Corequisites:** There are no corequisites for this course.
Provides an overview of rail transportation: history, organizations, economics, safety, freight operations, track-train dynamics, signals and communications, motive power and equipment, track components, construction and maintenance. The basic objective of the course is to gain an understanding of railroads as a transportation industry that merges a number of engineering fields as well as other disciplines that contribute to the success of a complex, growth-oriented industry.

**CE 486 Civil Engineering Design & Synthesis I 1R-3L-2C F**
**Prerequisites:** RH 330 Technical & Professional Communication 4R-0L-4C S, and CE 460 Introduction to Environmental Engineering 4R-0L-4C S
**Corequisites:** CE 450 Civil Engineering Codes & Regulations 4R-0L-4C F
Civil engineering projects submitted by corporate and governmental sponsors will be initiated by small teams of students to implement principles used in planning, design, and synthesis. Learning objectives include contracting, concept development, concept feasibility, planning and scheduling design work, data collection for subsequent design.

**CE 487 Technical System Design & Synthesis 2R-2L-2C W**
**Prerequisites:** CE 486 Civil Engineering Design & Synthesis I 1R-3L-2C F
**Corequisites:** CE 488 Civil Engineering Design & Synthesis II 1R-2L-2C W
Technical system design of subdisciplinary elements of civil engineering projects submitted by corporate and governmental sponsors will be completed by individual team members to fulfill the needs of a team project initiated with CE486 and continuing in CE488. The “x” will be used to identify subdiscipline designation (c = general civil
design, e = environmental, g = geotechnical, s = structural, t = transportation, w = water resources).

**CE 488 Civil Engineering Design & Synthesis II 1R-2L-2C W**
- **Prerequisites:** CE 486 Civil Engineering Design & Synthesis I 1R-3L-2C F
- **Corequisites:** CE 487 Technical System Design & Synthesis 2R-2L-2C W

Project management by small teams for civil engineering projects submitted by corporate and governmental sponsors will continue. Learning objectives include coordinate of major design work in subdisciplines, progress reporting to the client, critical path model management to keep the project on schedule to fulfill the needs of a team project initiated with CE486 and continuing in CE487.

**CE 489 Civil Engineering Design & Synthesis III 1R-3L-2C S**
- **Prerequisites:** CE 487 Technical System Design & Synthesis 2R-2L-2C W, and CE 488 Civil Engineering Design & Synthesis II 1R-2L-2C W
- **Corequisites:** There are no corequisites for this course.

Civil engineering projects submitted by corporate and governmental sponsors will be completed. Final recommendations and engineering designs will be presented to the sponsors with due attention to the social, economic, and environmental constraints of the project. Learning objectives include construction planning and cost, final reporting, and public presentation of findings.

**CE 490 Directed Studies CE 490 Directed Studies 1-4C Arranged F,W,S**
- **Prerequisites:** Approval of department head, adviser, and course instructor
- **Corequisites:** There are no corequisites for this course.

Provides the opportunity for the civil engineering students to do a selected project of mutual interest to them and a faculty member or make up for deficiencies in transfer credit hours and topics. Credit is assigned up to 4 credits per term with a maximum of 8 credits toward graduation.

**CE 520 Structural Engineering Practicum 0R-12L-4C**
- **Prerequisites:** Grad or consent of instructor
- **Corequisites:** There are no corequisites for this course.

Structural engineering practicum approved by the department.

**CE 521 Matrix Methods for Structural Analysis 4R-0L-4C F**
- **Prerequisites:** CE 321 Structural Mechanics I 4R-0L-4C F
- **Corequisites:** There are no corequisites for this course.

Derivation of the direct stiffness method for truss and frame elements. Derivation of the finite element method for 2D plate elements. Requires development of computer programs to implement the direct stiffness method.

**CE 522 Structural Dynamics 4R-0L-4C W**
- **Prerequisites:** Grad or consent of instructor
- **Corequisites:** CE 521 Matrix Methods for Structural Analysis 4R-0L-4C F

Analysis and behavior of structural members and systems subject to dynamic loads including basic theory for single-degree-of-freedom and multi-degree-of-freedom analytical models of civil engineering structures; seismic hazard analysis and methods of analysis for seismic loads; response spectra; time history; and linear and nonlinear methods.

**CE 523 Advanced Solid Mechanics 4R-0L-4C W**
Prerequisites: Grad or consent of instructor
Corequisites: There are no corequisites for this course.
The fundamentals of elasticity are introduced and related to various problems such as beams on elastic foundations, unsymmetrical bending, torsion of thin walled members, and curved beams. Introduction to the analysis and modeling techniques for existing and repaired structures. Design of retrofit measures for a variety of structures using advanced composite materials.

CE 524 Building Design 4R-0L-4C S
Prerequisites: CE 421 Structural Mechanics II 4R-0L-4C W* *Graduate standing (course not required); or consent of instructor and CE 421
Corequisites: There are no corequisites for this course.
Advanced structural analysis and design concepts for buildings: material nonlinearity, plastic design, pushover analysis, bracing, floor vibrations. Course culminates in a design project.

CE 525 Bridge Engineering 4R-0L-4C S
Prerequisites: CE 421 Structural Mechanics II 4R-0L-4C W, and CE 431 Structural Design in Steel I 3R-0L-3C S, and CE 432 Structural Design in Concrete I 3R-0L-3C W
Corequisites: There are no corequisites for this course.
Deals with the various types of bridge structures, the materials of which they are constructed and the manner in which loads are transmitted to the foundation. Introduces concepts of bridge engineering by providing the students with the necessary knowledge and skills to apply the AASHTO LRFD specifications for the analysis and design of highway and bridge superstructure components.

CE 530 Structural Design in Timber 4R-0L-4C On Demand
Prerequisites: Senior class standing or consent of instructor
Corequisites: There are no corequisites for this course.
Presents the analysis and design of structures constructed of timber.

CE 532 Structural Design in Concrete II 3R-3L-4C F
Prerequisites: CE 432 Structural Design in Concrete I 3R-0L-3C W
Corequisites: There are no corequisites for this course.
Advanced topics in reinforced concrete analysis and design such as serviceability, slender columns, two-way slabs, and strut-and-tie modeling.

CE 533 Connections & Detailing 4R-0L-4C S
Prerequisites: CE 431 Structural Design in Steel I 3R-0L-3C S, and CE 432 Structural Design in Concrete I 3R-0L-3C W
Corequisites: There are no corequisites for this course.
Analysis and design of structural systems with emphasis on detailing requirements; behavior of bolted and welded connections, including gusset plates, moment-resistant connections, and simple connections; design and analysis of base plate and anchoring systems; and an introduction to seismic detailing requirements.

CE 534 Structural Design in Masonry 4R-0L-4C On Demand
Prerequisites: CE 432 Structural Design in Concrete I 3R-0L-3C W
Corequisites: There are no corequisites for this course.
Presents the analysis and design of structures constructed of masonry. Material properties, beam design, unreinforced and reinforced walls, columns and pilasters,
seismic provisions, diaphragms, shear-walls, connections, other masonry units - stone, marble, etc.

**CE 535 Structural Design in Prestressed Concrete 4R-0L-4C F**
**Prerequisites:** CE 432 Structural Design in Concrete I 3R-0L-3C W
**Corequisites:** There are no corequisites for this course.
Analysis and design of prestressed concrete structures. Beams, slabs, loss of prestress, deflections, precast construction.

**CE 536 Advanced Soil Mechanics 4R-0L-4C On Demand**
**Prerequisites:** CE 436 Foundation Engineering 4R-0L-4C F
**Corequisites:** There are no corequisites for this course.
Presents a comprehensive treatment of principles of soil mechanics in relation to soil compaction, effective stress, influence of fluid flow on soil behavior, pore pressure development in undrained loading, consolidation, settlement problems, lateral soil pressures, shear strength and stability problems.

**CE 537 Retaining Structure Design 4R-0L-4C W**
**Prerequisites:** CE 336 Soil Mechanics 3R-3L-4C F, and CE 432 Structural Design in Concrete I 3R-0L-3C W
**Corequisites:** There are no corequisites for this course.
Covers the determination of earth pressures, selection of appropriate retaining wall types, and design of commonly used retaining structures. Includes both external (geotechnical) and internal (structural) analysis.

**CE 561 Air Pollution 4R-0L-4C W**
**Prerequisites:** Grad or consent of Instructor
**Corequisites:** There are no corequisites for this course.
Fundamentals of meteorology, air pollution health impacts, particulate control mechanisms and devices, and gaseous pollutant control mechanisms and devices. Course includes detailed design projects involving major air pollution control devices. Cross-listed with CHE450.

**CE 562 Advanced Wastewater Treatment 4R-0L-4C**
**Prerequisites:** CE 463 Unit Operations in Environmental Engineering 4R-0L-4C F
**Corequisites:** There are no corequisites for this course.
Covers the theory, design and analysis of biological processes for the treatment of wastewater. Treatment processes include suspended and attached growth processes, aerobic and anaerobic processes, biological nutrient removal, aeration and gas transfer, and biosolids processing.

**CE 563 Advanced Water Treatment 4R-0L-4C**
**Prerequisites:** CE 463 Unit Operations in Environmental Engineering 4R-0L-4C F
**Corequisites:** There are no corequisites for this course.
Covers the theory, design and analysis of physical and chemical processes for the treatment of drinking water. Treatment processes include coagulation and flocculation, gravity separation, granular and membrane filtration, disinfection, air stripping, adsorption, ion exchange, and disinfection.

**CE 564 Aquatic Environmental Chemistry 4R-0L-4C F**
**Prerequisites:** Senior or Graduate student standing
**Corequisites:** There are no corequisites for this course.
Emphasis equilibrium relationships of importance in understanding both natural waters and wastewaters. The carbonate system and the concept of pH as a master variable are stressed.

**CE 565 Solid & Hazardous Waste Regulation & Treatment 4R-0L-4C On Demand**
**Prerequisites:** CE 460 Introduction to Environmental Engineering 4R-0L-4C S
**Corequisites:** There are no corequisites for this course.
Covers solid and hazardous waste management, including characterization, collection system design, waste minimization, design of landfills and incinerators, and remediation principles.

**CE 566 Environmental Management 4R-0L-4C On Demand**
**Prerequisites:** Graduate student standing
**Corequisites:** There are no corequisites for this course.
Environmental management at an industrial facility is examined in detail. Topics include the determination of environmental impacts, summaries of main environmental laws and standards, decision-making tools, and case studies of various industries.

**CE 567 Applied Hydrologic Modeling 4R-0L-4C**
**Prerequisites:** CE 471 Water Resources Engineering 4R-0L-4C W
**Corequisites:** There are no corequisites for this course.
Watershed planning and stormwater management strategies are examined using computer simulation models. With an emphasis on conceptual foundation, students will be introduced to some of the most widely used models in the fields of hydrology and stormwater quantity management. Topics examined include watershed loss, transform, and routing methods, as well as model configuration, calibration, and evaluation.

**CE 568 Surface Water Quality Modeling 4R-0L-4C S**
**Prerequisites:** CE 460 Introduction to Environmental Engineering 4R-0L-4C S or consent of instructor
**Corequisites:** There are no corequisites for this course.
Covers the mathematical analysis of transport and fate of pollutants in natural surface waters and their impact on water quality using analytical and numerical models. Includes one- and two-dimensional steady-state and transient models. Pollutants examined include oxygen-demanding organics, nutrients and toxic compounds.

**CE 569 Treatability Studies 2R-6L-4C On Demand**
**Prerequisites:** CE 563 Advanced Water Treatment 4R-0L-4C S or CHE 461 Unit Operations in Environmental Engineering 4R-0L-4C F or W
**Corequisites:** There are no corequisites for this course.
Emphasizes use of laboratory bench scale evaluations of unit operations and processes important in the treatment and disposal of specific types of organic and inorganic wastes of significance in industrial and site remediation situations. Student laboratory projects and presentations.

**CE 570 Modeling Open Channel Hydraulics 4R-0L-4C W**
**Prerequisites:** CE 371 Hydraulic Engineering 3R-3L-4C F
**Corequisites:** There are no corequisites for this course.
Presents steady and unsteady flow problems in open channels and pipes, dealing with mechanics of flow over rigid and mobile boundaries. Covers analysis of river dynamics and hydraulic principles in stormwater conveyance through numerical and computer modeling.
CE 571 Environmental River Mechanics 3R-3L-4C S
Prerequisites: CE 371 Hydraulic Engineering 3R-3L-4C F
Corequisites: There are no corequisites for this course.
Concepts of fluvial geomorphology and fluvial hydraulics are examined, including natural stream flow, sediment transport, and ecological processes in alluvial rivers. Students will apply these principles to solve common design problems of channel instability and rehabilitation of impaired streams. Students will visit local streams to perform field data collection of channel geometry, bed and bank material, and water quality.

CE 573 Groundwater Analysis 4R-0L-4C
Prerequisites: CE 471 Water Resources Engineering 4R-0L-4C W
Corequisites: There are no corequisites for this course.
Covers hydrodynamics of flow through porous media. The primary emphasis is on the analysis of steady and unsteady flow in confined and unconfined aquifers. Groundwater modeling is introduced.

CE 589 Environmental Engineering Design & Synthesis 4R-12L-8C F,W,S
Prerequisites: Graduate Standing
Corequisites: There are no corequisites for this course.
Environmental engineering projects submitted by external sponsors are undertaken by small teams of students to develop advanced principles used in planning, design, and synthesis. Final recommendations and engineering designs are presented to the sponsors with due attention to the social, economic, and ethical constraints of the project. Each student team also prepares a manuscript of the completed project that is suitable for publication in a peer-reviewed professional journal. The final report to the sponsor and the manuscript prepared by the team must be approved by the team's graduate committee comprised of at a minimum, the course instructor, a faculty mentor from the CE department, and a faculty external to the CE department.

CE 590 Special Problems 2/4R-0L-2/4C F,W,S
Prerequisites: Consent of instructor
Corequisites: There are no corequisites for this course.
Special problems or reading by special arrangement with the faculty.

CE 597 Special Projects in Civil Engineering Variable Credit F,W,S
Prerequisites: Permission of instructor
Corequisites: There are no corequisites for this course.
A special project, or series of problems, or research problem is assigned to or selected by the student. A comprehensive report must be submitted at the conclusion of the project. Not to be used as a substitute for CE 599, Thesis Research. Variable credit. May be repeated up to a maximum of eight credits.

CE 598 Special Topics in Civil Engineering Variable Credit
Prerequisites: There are no prerequisites for this course.
Corequisites: There are no corequisites for this course.
Studies in advanced topics of current interest.

CE 599 Thesis Research As assigned F,W,S
Prerequisites: There are no prerequisites for this course.
Corequisites: There are no corequisites for this course.
Graduate students only. Credits as assigned; however, not more than 12 credits will be applied toward the requirements of the M.S. degree.

**CE CPT Curricular Practical Training 1R-0L-1C**
**Prerequisites:** Consent of department head
**Corequisites:** There are no corequisites for this course.

Any international student with an F-1 Visa employed by any company in the form of an internship, co-op, or practicum must enroll in a CPT course. The CPT experience is to be complimentary training to the student’s curriculum and should contribute substantially to his/her learning experience. Students must have an offer of employment from a company prior to registering for this course. The CPT must be approved by the Department Head, Director of International Student Services, and the student’s advisor. Students are required to submit a report at the conclusion of the employment to his/her instructor to receive a grade for the CPT experience.

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