CIVIL ENGINEERING

College of Engineering and Computer Science

Program Description

Civil Engineering involves the application of scientific principles and knowledge of mathematics and computers to the planning, analysis, design, and construction of all types of private and public works. Reduction of air and water pollution, disposal of hazardous wastes, renewal of our old cities, planning and building of new communities, providing water, power, and high-speed ground transportation systems are the responsibilities of the civil engineer. It is a continual challenge to the civil engineer to provide these services efficiently by the construction of dams, buildings, bridges, tunnels, highways, airports, waterways, and waste handling facilities in harmony with the natural environment.

Because of the broad range of demands on the civil engineer's services, the undergraduate program is devoted to fundamental principles in mathematics; basic and engineering sciences; the spectrum of Civil Engineering practice in both analysis and design; and required courses in the humanities and the social sciences, so that engineers may better relate to the world and society they serve. The upper division program permits students to select 9 units (3 courses) of electives. Students may increase the breadth or depth of their knowledge in Civil Engineering by selecting these electives in several areas: environmental and water quality engineering, geotechnical engineering, structural engineering, transportation, and water resources engineering.

Degree Programs

BS in Civil Engineering (http://catalog.csus.edu/colleges/engineering-computer-science/engineering-civil/bs-in-civil-engineering/)

MS in Civil Engineering (http://catalog.csus.edu/colleges/engineering-computer-science/engineering-civil/ms-in-civil-engineering/)

Cooperative Education Program (Work Experience)

Accreditation

In addition to California State University, Sacramento's full accreditation by the Western Association of Schools and Colleges, the Bachelor of Science in Civil Engineering is also individually accredited by ABET, Inc.

Notice to Students RE: Professional Licensure and Certification

California State University programs for professions that require licensure or certification are intended to prepare the student for California licensure and certification requirements. Admission into programs for professions that require licensure and certification does not guarantee that students will obtain a license or certificate. Licensure and certification requirements are set by agencies that are not controlled by or affiliated with the California State University and licensure and certification requirements can change at any time.

The California State University has not determined whether its programs meet other states' educational or professional requirements for licensure and certification. Students planning to pursue licensure or certification in other states are responsible for determining whether, if they complete a California State University program, they will meet their state's requirements for licensure or certification. This disclosure is made pursuant to 34 CFR §668.43(a)(5)(v)(C).

Special Features

- The BSCE degree is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (EAC/ABET).
- A notable strength of the program is that most faculty are licensed professional engineers in California and have practical experience in industry. Thus, faculty bring an ability to relate theory to practice, and the program prepares the student for the profession as well as for advanced study.
- Emphasis is placed on design which is the definition and solution of engineering problems in a practical manner. Lower division and first semester junior year coursework provides the preparation for design in courses such as mathematics, physics, descriptive geometry, CAD, surveying, computer applications, and engineering economics. Design courses are available to students in their last three semesters including a senior design project course in the final semester.
- Class sizes are small providing for close interaction between students and faculty. This interaction is enhanced in laboratory courses which are an integral part of the curriculum.
- Computers are used in many courses and students have free access to computer laboratories.
- Communication skills and social and ethical responsibilities of professional practice are emphasized.
- Students are encouraged to participate in the Student Chapter of American Society of Civil Engineers and other student organizations, to develop organizational skills, and to interact with practicing civil engineers.
- Sacramento, the State Capital and the seat of county government, provides proximity to city, county, state and federal agencies, and many consulting firms with Civil Engineering departments. Thus, students have a unique environment to draw upon for semester projects, part-time or summer employment, and career opportunities.

Program Educational Objectives

The objectives of the civil engineering are to prepare graduates to:

- ethically apply their hands-on, practice-oriented civil engineering education to succeed professionally;
- engage in lifelong learning through graduate education, professional development, and/or active involvement in professional organizations; and
- communicate effectively on multi-disciplinary teams to address diverse challenges, creating solutions that serve the general public.

Academic Policies and Procedures

The following is a summary of policies and procedures specific to the Department of Civil Engineering. Other University policies and procedures in this catalog also apply to Civil Engineering majors. The Department will not hear petitions for deviation from articulated policies made by students who disregard catalog policy.

- **Course Repeat Policy:** Undergraduate engineering and Civil Engineering courses that are used to meet the Bachelor of Science in Civil Engineering degree requirements may be repeated only twice (for a total of three attempts). Grades of the second and third attempt will be averaged in grade point calculations.
- **Reinstatement Policy:** Students seeking reinstatement to the Civil Engineering major must complete a Reinstatement Petition (obtained at Admissions and Records). That petition will be reviewed by the Department Chair for approval or rejection.

Note: The only basis for reinstatement is the expectation (supported by evidence provided by the student) that the student is now likely to progress towards the satisfactory completion of the Department's degree requirements in a timely manner.

- **Minimum Grade Requirements:** The purpose of this requirement is to assure that all Civil Engineering majors attain the minimum level of competency in all their coursework required for a Bachelor of Science Civil Engineering Degree.
  All required courses in the major, all electives in the major, ENGL 5, and ENGL 20 must be completed with a grade of "C-" or better.
  A minimum grade point average of 2.0 ("C") is required in the major courses applied to the degree.
- **Incomplete Grades:** Incomplete grades are issued only in accordance with University policy. The student must be passing the course at the time an "Incomplete" is requested. An Incomplete Petition (obtained in the Department Office) must be submitted to the Department with the student's and the course instructor's signature. The Incomplete Petition must specify the work to be completed, the basis by which the student's final grade will be determined, and the last date for completion of the incomplete work. An incomplete grade that is not cleared by the set date will lapse to an F grade.

Career Possibilities

Bridge Engineer · Civil Engineer · Construction Engineer · Design Engineer · Environmental Engineer · Foundation Engineer · Geotechnical Engineer · Highway Engineer · Hydraulic Engineer · Hydrologic Engineer · Project Engineer · Public Works Engineer · Research Engineer · Sanitary Engineer · Soils Engineer · Structural Engineer · Traffic Engineer · Transportation Engineer · Urban Planner · Water Resources Engineer

Contact Information

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Department of Civil Engineering Website (http://www.ecs.csus.edu/ce/)

Faculty

ABADI, MASOUD

ARMSTRONG, RICHARD

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FELL, BENJAMIN

FOGARTY, JULIE

GARCIA, JOSE

HANSEN, KAREN L.

KHAN, GHAZAN

MAHMOOD, RAMZI J.

MATSUMOTO, ERIC E.

MERAYYAN, SAAD

MOTLAGH, AMIR

POINDEXTER, CRISTINA

SCOTT-HALLET, KIMBERLY

ZHU, TONGREN

CE 1. Civil Engineering Seminar. 1 Unit
General Education Area/Graduation Requirement: Understanding Personal Development (E)
Term Typically Offered: Fall, Spring

Introduces students to civil engineering as a profession. Topics include the technical disciplines (environmental, geotechnical, structural, transportation, and water resources), the role of civil engineers in planning, constructing and operating infrastructure, and professional responsibilities such as licensure and ethics. Case studies are used to explore both technical and nontechnical aspects of civil engineering projects such as design and environmental constraints, constructability, and social and political issues.

CE 4. Engineering Graphics and CAD. 2 Units
General Education Area/Graduation Requirement: Understanding Personal Development (E)
Term Typically Offered: Fall, Spring

In-depth graphic analysis and solution of typical three dimensional space problems by applying the principles of orthogonal projection. Fundamentals of interactive computer aided design and drafting. Lecture one hour; laboratory three hours.

CE 9. Plane and Topographic Surveying. 2 Units
Prerequisite(s): MATH 30 and CE 9L. CE 9L may be taken concurrently. MATH 30 may be taken concurrently. Not currently enrolled in CE 9.
Term Typically Offered: Fall, Spring

Methods for the measurement of distance, direction, angles and elevations. Computational methods for locating points, closing traverses and determining areas and earthwork volumes. Horizontal and vertical curves. Introduction to legal aspects of surveying, geodetic surveys, maps, boundary surveys and new technologies used in surveying. Lecture two hours.

CE 9L. Plane and Topographic Surveying Laboratory. 1 Unit
Prerequisite(s): MATH 30 and CE 9. CE 9 may be taken concurrently. MATH 30 may be taken concurrently. Not currently enrolled in CE 9L.
Term Typically Offered: Fall, Spring

Laboratory course that supports CE 9. Use of surveying instruments and measurement techniques in field setting. Laboratory three hours.
Note: This course requires safety training and personal protective equipment (PPE).

CE 39. Advanced Waste Treatment. 6 Units
Term Typically Offered: Fall, Spring

Continuation of CE 38A and CE 38B, and is designed to train operators in the safe and effective operation and maintenance of wastewater treatment plants. Provides information to operators of advanced wastewater treatment plants covering enhanced biological nutrient removal treatment processes as well as physical-chemical tertiary treatment processes and wastewater reclamation.
Credit/No Credit

CE 100. Engineering Geology. 2 Units
Prerequisite(s): ENGR 112; may be taken concurrently.
Term Typically Offered: Fall, Spring

Soil and rock mechanics and their relations to geological features influencing design, construction and maintenance of engineering projects. Lectures and field problems.

CE 101. Computer Applications in Civil Engineering. 3 Units
Prerequisite(s): ENGR 30 and CE 4; CE 4 may be taken concurrently.
Term Typically Offered: Fall, Spring

Development of programming- and algorithm-based problem-solving skills in civil engineering using modern programming and scripting languages and scientific computing programs. Application to numerical methods, data science, and visualization.

CE 130. Water Resources Engineering. 3 Units
Prerequisite(s): CE 1, CE 101, ENGR 115, ENGR 132, CE 130L. CE 130L may be taken concurrently. CE 101 may be taken concurrently. Not currently enrolled in CE 130.
Term Typically Offered: Fall, Spring

Hydrologic and hydraulic fundamentals which are common to water resources projects; introduction to reservoirs, dams, pipelines, channels, hydraulic machinery, ground water, water rights, statistical analysis, engineering economy applications, and water resources planning.

CE 130L. Hydraulics Laboratory. 1 Unit
Prerequisite(s): CE 101 and CE 130. CE 130 may be taken concurrently. CE 101 may be taken concurrently. WPJ Score of 70+ or equivalent. Not currently enrolled in CE 130L.
Term Typically Offered: Fall, Spring

Laboratory experiments relating the principles of fluid mechanics to real fluid flow. Laboratory three hours.

CE 131. Hydrology. 3 Units
Prerequisite(s): CE 130 and CE 130L. Not currently enrolled in CE 131.
Term Typically Offered: Fall only

Introduction to surface water hydrology for engineering. Evapotranspiration and infiltration prediction. Precipitation analysis, hydrograph and flood routing applications for civil engineering. Statistical applications in hydrology.

CE 132. Groundwater Engineering. 3 Units
Prerequisite(s): CE 130 and CE 130L. Not currently enrolled in CE 132.
Term Typically Offered: Spring only

Occurrence and movement of groundwater. Groundwater principles, groundwater flow, Darcy's Law, solutions of steady and unsteady flow problems. Confined and unconfined aquifers, leaky aquifers, pumping test design, and groundwater management.

CE 133. Design of Urban Water and Sewer Systems. 3 Units
Prerequisite(s): CE 130 and CE 130L. Not currently enrolled in CE 133.
Term Typically Offered: Fall only

Hydraulic design of water distribution and sewerage systems. Computer-assisted pipe network analysis. Analysis of pump systems. Pump station design. Other selected topics.

CE 134. Open Channel Hydraulics. 3 Units
Prerequisite(s): CE 130 and CE 130L. Not currently enrolled in CE 134. .
Term Typically Offered: Spring only

Civil engineering design problems in steady, uniform, gradually and rapidly varied open channel flow. Hydraulic analysis in structures, transitions, culverts, weirs and spillways. Channel design including roughness for subcritical and supercritical flow. Prediction of water surface profiles via simulation software.

CE 140. Transportation Engineering. 3 Units
Prerequisite(s): CE 1, CE 9, CE 9L, CE 101, ENGR 115, and CE 140L. CE 140L may be taken concurrently. CE 101 may be taken concurrently. Not currently enrolled in CE 140.
Term Typically Offered: Fall, Spring

Introduction to the fundamental topics in Transportation Engineering. Focus on roadway geometric design, layout considerations, pavement materials and design, traffic operations and analysis.

CE 140L. Transportation Engineering Laboratory. 1 Unit
Prerequisite(s): CE 1, CE 9, CE 9L, CE 101, ENGR 115, and CE 140. CE 140 may be taken concurrently. CE 101 may be taken concurrently. WPJ Portfolio Score of 3+ or equivalent. Not currently enrolled in CE 140L.
Term Typically Offered: Fall, Spring

Laboratory course that supports CE 140. Activities include speed survey and safety assessment, analysis of freeway level of service, analysis of intersection delay and level of service, roadway geometry design, and pavement design using field measurements, online datasets, and state-of-the-practice software. Laboratory three hours.
Note: This course requires safety training. This course requires personal protective equipment (PPE).

CE 141. Traffic Analysis and Design. 3 Units
Prerequisite(s): CE 140 and CE 140L. Not currently enrolled in CE 141.
Term Typically Offered: Spring only

Introduction to the fundamental principles of traffic operations, traffic data collection methods, intersection control, signal design and analysis techniques. Methods and software for designing and optimizing signalized and unsignalized intersection operation.

CE 142. Transportation Systems. 3 Units
Prerequisite(s): CE 140. Not currently enrolled in CE 142.
Term Typically Offered: Fall only

Transportation systems evaluation and management. Focus on transportation planning methods, including data analysis, estimation of future demand, evaluation of travel demand impacts on existing systems, and transportation system decision-making.

CE 144. Geometric Design of Highways. 3 Units
Prerequisite(s): CE 140, CE 140L
Term Typically Offered: Fall, Spring

Theory and practice of the principles of geometric design of highways and roads focusing on designing visual aspects of highways, highway classification, design controls and criteria, design elements, safety, vertical and horizontal alignment, cross section, intersections, and interchanges. Emphasis on the latest Federal and California design standards and tools, methods, and practices.

CE 150. Principles of Environmental Engineering. 2 Units
Prerequisite(s): CHEM 1E or CHEM 1A, ENGR 115, CE 1, CE 101, and CE 150L. CE 150L may be taken concurrently. CE 101 may be taken concurrently. Not currently enrolled in CE 150.
Term Typically Offered: Fall, Spring

Introduction to principles of environmental quality management. Physical and chemical principles affecting environmental quality including equilibrium and kinetics. Water quality parameters, their importance, and natural processes that affect them. Application of thermodynamic principles to environmental systems.

CE 150L. Environmental Engineering Laboratory. 1 Unit
Prerequisite(s): CHEM 1E or CHEM 1A, ENGR 115, CE 1, CE 101, and CE 150. CE 150 may be taken concurrently. CE 101 may be taken concurrently. WPJ Score of 70+ or equivalent. Not currently enrolled in CE 150L.
Term Typically Offered: Fall, Spring

This is the laboratory course that supports CE 150. Activities include water quality testing and computer modeling. Laboratory three hours.
Note: This course requires safety training and personal protective equipment (PPE).

CE 151. Environmental Engineering Practice. 2 Units
Prerequisite(s): CE 150. Not currently enrolled in CE 151.
Term Typically Offered: Fall, Spring

Introduction to environmental engineering professional practices. Water and wastewater treatment processes. Solid waste management. Air quality parameters and management. Sustainability.

CE 152. Stormwater Management. 3 Units
Prerequisite(s): CE 150, CE 150L, CE 130, CE 130L
Term Typically Offered: Spring only

Introduction to the principles and practices of urban stormwater management. Hydrologic and hydraulic design of small drainage systems. Physical and chemical principles affecting stormwater quality, environmental effects, and treatment. Choosing and designing Best Management Practices. Low Impact Development. Overview of requirements for managing construction runoff and erosion control.

CE 153. Design of Water Quality Control Processes. 3 Units
Prerequisite(s): CE 150B and ENGR 132. Not currently enrolled in CE 153.
Term Typically Offered: Spring only

Analysis and design of selected physical, chemical, and biological facilities for water purification and wastewater treatment. Emphasis is on design based on loading factors and integration of unit processes into treatment systems.

CE 156. Geoenvironmental Engineering. 3 Units
Prerequisite(s): CE 150B and CE 170; CE 150B may be taken concurrently. Not currently enrolled in CE 156.
Term Typically Offered: Not offered

Equilibrium distribution of contaminants among air, water and solid phases of soil systems; analysis and modeling of soil vapor extraction (SVE), pump and treat, and soil washing systems; movement of gasses in landfills; infiltration through landfill cover; geosynthetic liner systems; hazardous waste containment systems.

CE 160. Introduction to Structural Analysis. 3 Units
Prerequisite(s): CE 1, CE 101, ENGR 112, and (MATH 35 or MATH 100). Not currently enrolled in CE 160.
General Education Area/Graduation Requirement: Further Studies in Area B (B5), Upper Division Further Studies in Area B5
Term Typically Offered: Fall, Spring

Analysis of statically determinate and indeterminate beams, frames, and trusses. Includes energy principles, flexibility and stiffness analyses, and influence lines. Computers are used to aid in the solution of complex structural problems.

CE 160L. Structural Laboratory. 1 Unit
Prerequisite(s): CE 101 and ENGR 112. WPJ score of 70+ or equivalent. Not currently enrolled in CE 160L.
General Education Area/Graduation Requirement: Further Studies in Area B (B5), Upper Division Further Studies in Area B5
Term Typically Offered: Fall, Spring

Introduction to the principles of structural analysis and design by testing of structural elements. Experimental verification of the assumptions of strength of materials. Introduction to laboratory techniques. Laboratory three hours.
Note: This course requires safety training. This course requires personal protective equipment (PPE).

CE 163. Structural Steel Design. 3 Units
Prerequisite(s): CE 160. Not currently enrolled in CE 163.
Term Typically Offered: Fall, Spring

Theory and practice in design of structural steel members and connections using current design specifications. Design of tension and compression members, laterally supported and unsupported beams, beam-columns, and bolted and welded connections.

CE 164. Reinforced Concrete Design. 3 Units
Prerequisite(s): CE 160 and CE 160L. CE 160L may be taken concurrently. Not currently enrolled in CE 164.
Term Typically Offered: Fall, Spring

Introduction to reinforced concrete design according to American Concrete Institute (ACI) 318 Building Code, including: design and safety concepts; loads and load path; structural systems; material properties; flexural analysis and design of reinforced concrete beams and one-way slabs; development of reinforcement; serviceability; shear; columns; and other topics.

CE 165. Masonry Design. 3 Units
Prerequisite(s): CE 160. Not currently enrolled in CE 165
Term Typically Offered: Spring only

History of masonry. Masonry materials. Masonry as a structural material. Design of masonry beams, concentrically and eccentrically loaded columns, walls for vertical and lateral loading including effects of wind and seismic forces. Design of a small building for wind and seismic loading including torsional effects.

CE 166. Seismic Behavior of Structures. 3 Units
Prerequisite(s): CE 101, CE 160, and ENGR 110. Not currently enrolled in CE 166
Term Typically Offered: Fall, Spring

Analyzes simple structures' response to dynamic loads with emphasis on response to earthquake ground motion. Introduction to multi-story buildings dynamics. Modal and approximate analyses of earthquake response. Dynamic analysis and building code procedures.

CE 168. Prestressed Concrete Design. 3 Units
Prerequisite(s): CE 160 and CE 164. CE 164 may be taken concurrently. Not currently enrolled in CE 168.
Term Typically Offered: Fall only – even years

Introduction to prestressed concrete design, focusing on bridges and buildings. Topics include: basic concepts; technology for fabrication and construction; material properties; flexural analysis and design for non-composite and composite beams; development of strands; prestress losses; camber and deflections; shear; and other topics. Design conforming to American Concrete Institute (ACI) 318 Building Code or AASHTO LRFD Bridge Design Specifications is emphasized, as appropriate.

CE 169. Timber Design. 3 Units
Prerequisite(s): CE 160. Not currently enrolled in CE 169.
Term Typically Offered: Fall only

Wood as a structural material. Design of sawn and glulam beams, concentrically and eccentrically loaded columns, shear walls, flexible diaphragms and connections for vertical and lateral loading including effects of wind and seismic forces.

CE 170. Soil Mechanics. 3 Units
Prerequisite(s): CE 1, CE 100, CE 101, ENGR 112, and CE 170L. CE 170L may be taken concurrently. CE 101 may be taken concurrently. Not currently enrolled in CE 170.
Term Typically Offered: Fall, Spring

Composition and properties of soils; soil classification; soil compaction; soil-water interaction, including permeability and seepage analyses; soil stresses; soil compressibility, consolidation, and settlement analysis; soil shear strength.

CE 170L. Soil Mechanics Laboratory. 1 Unit
Prerequisite(s): Complete CE 1, CE 100, CE 101, ENGR 112, CE 170. CE 170 may be taken concurrently. CE 101 may be taken concurrently. WPJ Score of 70+ or equivalent. Not currently enrolled in CE 170L.
Term Typically Offered: Fall, Spring

Laboratory course that supports CE 170. Activities include soil testing and analysis of geotechnical site investigation data. Laboratory three hours.
Note: This course requires safety training and personal protective equipment (PPE).

CE 171. Soil Mechanics and Foundation Engineering. 3 Units
Prerequisite(s): CE 170 and CE 170L. Not currently enrolled in CE 171.
Term Typically Offered: Spring only

Lateral earth pressures and principles of retaining wall design; slope stability analysis and principles of slope stabilization design; ultimate bearing capacity of soils, allowable bearing pressures and settlement of structures; principles of foundation design including shallow foundations and deep foundations.

CE 175. Geotechnical Earthquake Engineering. 3 Units
Prerequisite(s): CE 170 and CE 170L. Not currently enrolled in CE 175.
Term Typically Offered: Fall only

Introduction to seismology and seismic hazard analysis; determination of building code design loads; prediction of soil-site effects; evaluation of liquefaction triggering, cyclic softening and associated consequences; introduction to mitigation techniques for liquefaction and ground failure hazards.

CE 182. Introduction to GIS in Civil Engineering. 3 Units
Prerequisite(s): ENGR 115, CE 9, CE 9L, and (CE 130 or CE 140 or CE 150 or CE 170). Not currently enrolled in CE 182.
Term Typically Offered: Fall only

Fundamental geographic information system (GIS) concepts; GIS data acquisition and analysis; GIS analytical methods. Lab exercises with GIS software used to introduce students to typical uses of GIS in civil engineering. This course may be paired with the graduate-level course GIS Applications in Civil Engineering. Lecture two hours; laboratory three hours.

CE 183. Concrete Technology. 3 Units
Prerequisite(s): ENGR 112.
Term Typically Offered: Spring only

History of portland cement, production, hydration, aggregates, supplementary cementitious materials, chemical admixtures, fresh and hardened concrete properties, concrete mixture design, and concrete construction. Introduction to concrete durability, concrete repair, and advances in concrete technology.

CE 190. Civil Engineering Project Skills. 3 Units
Prerequisite(s): CE 130 or CE 140 or CE 150 or CE 160 or CE 170. WPJ Score of 70+ or equivalent. Not currently enrolled in CE 190.
General Education Area/Graduation Requirement: GE AREA D
Term Typically Offered: Fall, Spring

Introduction to professional engineering practice through case studies of existing projects, including estimating, scheduling, and specifications. Evaluation of design alternatives for engineering projects using principles of engineering economy and cost benefit analysis. Engineering ethics and professional responsibilities.
Note: This course is intended to be taken in the final year of study before taking CE 191.

CE 191. Senior Project. 3 Units
Prerequisite(s): CE 190
Term Typically Offered: Fall, Spring

Culminating degree requirement. Completion of a conceptual design and evaluation of alternatives under realistic constraints for proposed infrastructure projects. Students work in teams with practicing professionals providing mentoring. Draws upon full educational experience to date. Lecture two hours. Laboratory three hours.
Note: This course must be taken in the final semester.

CE 194. Career Development in Civil Engineering. 1 Unit
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Designed for Civil Engineering students making career decisions. Instruction will include effective career planning strategies and techniques including skill assessments, employment search strategy, goal setting, time management, interview techniques and resume writing. Lecture one hour.
Note: Units earned cannot be used to satisfy major requirements. Cross Listed: ENGR 194, EEE194

Credit/No Credit

CE 195. Fieldwork in Civil Engineering. 1 - 3 Units
Prerequisite(s): Petition approval by supervising faculty member and Department chair.
Term Typically Offered: Fall, Spring

Supervised work experience in civil engineering with public agencies or firms in the industry.
Note: May be repeated for credit.

Credit/No Credit

CE 195A. Professional Practice. 1 - 12 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science.
Note: Requires satisfactory completion of the work assignment and a written report.

Credit/No Credit

CE 196K. Solid and Hazardous Waste Management. 3 Units
Prerequisite(s): CE 150 and CE 150L
Term Typically Offered: Fall only

Design and analysis of problems associated with storage, collection, processing, recycling, and disposal of solid and hazardous wastes. Engineering design, planning, and analysis of integrated waste management system with resource recovery, composting, incineration, and landfill disposals. Introduction to the regulation of solid and hazardous wastes.

CE 199. Special Problems. 1 - 3 Units
Term Typically Offered: Fall, Spring

Individual projects or directed reading.
Note: Open to students judged capable of carrying out individual work. Admission requires departmental approval and sponsorship of a supervising faculty member. Cannot be used as a technical elective in the major. Consult the CE Department for admission procedures and other requirements. May be repeated.

CE 199E. Independent Study Technical Elective. 3 Units
Prerequisite(s): GPA of 2.5 or greater in the upper division courses of the major; grade of "B" or better in the required major course associated with the proposed area of study (CE 130 or CE 140 or CE 150 or CE 160 or CE 170).
Term Typically Offered: Fall, Spring

Individual project, research, or directed reading on an advanced topic.
Note: Open to only those students prepared and capable of carrying out independent work.

CE 200. Civil Engineering Professional Writing. 3 Units
Term Typically Offered: Fall, Spring

Writing workshop course designed to immerse graduate students in the discourse of civil engineering. Instruction and practice in the writing process, professional writing styles used in the discipline, and editing. Multiple writing assignments totaling a minimum of 5000 words will be required.

CE 230. Water Resources Planning. 3 Units
Prerequisite(s): CE 281 or instructor permission.
Term Typically Offered: Fall only – odd years

Application of single and multi-objective planning to the design and operation of water resources projects. Objectives and constraints for water projects, criteria and procedures for evaluation, planning under uncertainty. Application in water development and water quality planning, with case studies.

CE 231. Hydrometeorology. 3 Units
Prerequisite(s): CE 130 or CE 131 and ENGR 115.
Term Typically Offered: Spring only – odd years

Analyses of hydrologic processes closely linked to the atmosphere: evaporation, evapotranspiration, precipitation, and snowmelt. Penman and Penman-Montieth evaporation models, the eddy covariance method for land-atmosphere vapor and energy fluxes, atmospheric rivers and their impact on California water resources.

CE 232. Groundwater Hydrology. 3 Units
Prerequisite(s): CE 130 or instructor permission.
Term Typically Offered: Fall only – even years

Occurrence and movement of groundwater; physical characteristics of aquifers; analysis of steady-state groundwater flow problems by mathematical, digital computer, electrical analog and graphical methods; analysis of unsteady-state problems in confined and unconfined, aquifers; multiple well systems.

CE 234. Advanced Engineering Hydraulics. 3 Units
Prerequisite(s): CE 130 or equivalent, or instructor approval.
Term Typically Offered: Spring only – even years

Steady uniform and non-uniform open channel flows including gradually, rapid and spatially varied flows; analysis of supercritical flow in transition; basic principles of unsteady flows; long wave theory; Saint-Venant Equations and their solutions including method of characteristics, explicit and implicit finite difference numerical methods.

CE 235. Hydrologic Modeling. 3 Units
Prerequisite(s): CE 234 or equivalent.
Term Typically Offered: Spring only – odd years

Theories and structure of hydraulic model components; application of HEC-RAS (River Analysis System) and HEC-HMS (Hydrologic Modeling System) computer programs; emphasis on flood routing methods; dam safety analysis methodology including dam break and dam overtopping cases; application of microcomputers in hydraulics computations.

CE 241. Analysis and Control of Traffic Systems. 3 Units
Prerequisite(s): CE 140 or CE 142; CE 243 or instructor permission.
Term Typically Offered: Spring only – odd years

Traffic data collection and analysis, practical application of theoretical methods of analysis such as capacity, level of service, and queuing theory. Investigation of traffic control techniques such as actuated signals and signal systems, and study of management techniques for traffic congestion.

CE 242. Transportation Planning. 3 Units
Prerequisite(s): CE 142 or instructor permission.
Term Typically Offered: Fall only – odd years

Introduction to the complexities of comprehensive intermodal transportation planning. Study of transportation problems, system operating characteristics, alternative modes, and the planning process. Analyzes factors affecting travel behavior and methods of forecasting demand for travel by various modes.

CE 243. Traffic Flow Theory. 3 Units
Prerequisite(s): CE 140 or CE 142; ENGR 203 or instructor permission.
Term Typically Offered: Fall only – even years

Study of traffic flow characteristics including flow rate, speed, and density, at both the microscopic and macroscopic levels. Traffic flow analysis using the theoretical methods including capacity analysis, traffic stream models, shockwave analysis, and queuing analysis. Emphasis is on theory with demonstration of practical applications.

CE 244. Advanced Transportation Facility Design. 3 Units
Prerequisite(s): CE 140 or instructor permission.
Term Typically Offered: Fall only – even years

Advanced study of current topics in highway and mass transportation facility design including safety, curve design, pavement design and drainage facility design. Focuses on current design practice and recent or impending changes in design practice.

CE 245. Pavement Design. 3 Units
Prerequisite(s): CE 140 and CE 170.
Term Typically Offered: Spring only – even years

Fundamental principles of pavement analysis, design, and evaluation. Topics include pavement materials, mechanics, traffic and environmental loadings, pavement performance, design methods, construction and economic evaluation.

CE 251. Environmental Quality Processes I. 3 Units
Prerequisite(s): CE 150, 150L, and CE 151; or equivalent.
Term Typically Offered: Fall, Spring

Theory and practice of chemical processes affecting water quality. Chemical equilibrium, stoichiometry and kinetics of aqueous chemistry. Acid-base, precipitation-dissolution, oxidation-reduction, and coordination chemistry. Adsorption.

CE 252. Environmental Quality Processes II. 3 Units
Prerequisite(s): CE 150, 150L, and 151.
Term Typically Offered: Fall, Spring

Theory and practice of biological processes for controlling water. Stoichiometry and kinetics of microbial growth. Aerobic and anaerobic metabolism. Engineered suspended and attached growth systems. Introduction to sludge treatment.
Note: CE 251 recommended.

CE 253. Environmental Quality Processes III. 3 Units
Prerequisite(s): CE 150, 150L, and 151; or equivalent.
Term Typically Offered: Fall, Spring

Theory and practice of physical and chemical processes used in engineered water and wastewater systems. Adsorption, ion exchange, gas transfer, membrane processes, coagulation, flocculation, sedimentation, filtration, precipitation, disinfection, and stripping. Physical/chemical reactors.
Note: CE 251 recommended.

CE 254. Water Quality Management. 3 Units
Prerequisite(s): CE 170 or equivalent, CE 252A recommended, or instructor permission.
Term Typically Offered: Fall, Spring

Examination of pollution sources and effects on water bodies, and the management issues and tools used to protect environmental quality. Topics include point and nonpoint pollution sources, interactions in the environment, Federal and State laws, water quality objectives, beneficial uses, and regulatory mechanisms such as basin plans and total maximum daily loads (TMDLs). Emphasis is on surface water.

CE 255. Transport of Chemicals in Soil Systems. 3 Units
Prerequisite(s): MATH 45. Graduate status.
Term Typically Offered: Fall, Spring

Study of the mechanics of movement of chemicals in soil, including equilibrium and partition models, development of mass transport equations in porous media, analytical solution for one-dimensional transport, lumped parameter transport model (linear reservoir model), transport of reactive and conservative chemicals numerical solutions of transport models, transport in the unsaturated zone and coupled models for saturated and unsaturated zone.

CE 260. Matrix Structural Analysis. 3 Units
Prerequisite(s): CE 160.
Term Typically Offered: Fall only – even years

Flexibility and stiffness methods of structural analysis are applied to two- and three-dimensional framed structures. Use of computer software to perform analysis is discussed in detail. Techniques of computer modeling are discussed.

CE 261. Finite Element Analysis. 3 Units
Prerequisite(s): CE 260 or instructor permission.
Term Typically Offered: Spring only – odd years

Continuation of CE 260 with extension of theory to allow for the analysis of a wider variety of structures. Structural analysis software is used for the analysis of three-dimensional structures. Fundamentals of the finite element method and computer modeling with applications to structural problems.

CE 262. Nonlinear Structural Analysis. 3 Units
Prerequisite(s): CE 260
Term Typically Offered: Spring only – odd years

Theory and applications of nonlinear structural analysis including geometric and material nonlinear effects. Stability issues and second-order analysis methods are discussed in the context of moment amplification effects, member buckling, and the behavior of structural elements and frames undergoing large deformations. Inelastic material behavior and stress resultant plasticity concepts within a line-type element framework. Computer implementation of geometric nonlinear behavior.

CE 263. Advanced Steel Design. 3 Units
Prerequisite(s): CE 163 or instructor permission
Term Typically Offered: Spring only – even years

Advanced design methodology of steel structures using Load and Resistance Factor Design (LRFD). System level behavior, especially from a seismic loading perspective, is integrated into the design of steel components and connections. Other topics include plate girder design, plastic design of indeterminate systems, design of moment frame systems, and design of braced-frame systems.

CE 264. Advanced Design in Reinforced Concrete. 3 Units
Prerequisite(s): CE 160, CE 163, CE 164.
Term Typically Offered: Spring only – even years

Advanced topics in behavior and design in reinforced concrete. Detailing for seismic response.

CE 266. Dynamics and Earthquake Response of Structures. 3 Units
Prerequisite(s): CE 160; or equivalent.
Term Typically Offered: Fall only – odd years

Response of structures modeled as single-degree systems to harmonic, periodic, and arbitrary excitation and earthquake ground motion; effects of damping and material nonlinearity; numerical methods using spreadsheets; response spectra. Response of structures modeled as multi-degree systems: modeling of structure mass, damping and elastic stiffness; solution by modal superposition; time-history and response spectrum analysis; implications for codes for earthquake-resistant design. Microcomputer software is extensively used.

CE 267. Structural Systems for Buildings. 3 Units
Prerequisite(s): CE 163, CE 164, and CE 166; or equivalent
Term Typically Offered: Spring only – even years

Analysis and design of structural systems for buildings including frames, shear walls, and tubes; interaction between structural systems; secondary effects including geometric and material nonlinearities.

CE 268. Pre-stressed Concrete Bridge Design. 3 Units
Prerequisite(s): CE 164 or instructor approval.
Term Typically Offered: Fall only – even years

Behavior and design of short and medium-span prestressed concrete bridges using American Association of State Highway and Transportation Officials (AASHTO) Load Resistance Factor Design (LRFD) specifications. Topics include: bridge types, aesthetics; design process; superstructure load types and live load analysis; limit states and load combinations; prestressed concrete materials; flexural analysis and design; shear analysis and design; and introduction to substructure analysis and design, including seismic design criteria. A team project is required.

CE 270. Advanced Soil Mechanics and Foundation Engineering I. 3 Units
Prerequisite(s): CE 170 and CE 170L or equivalent.
Term Typically Offered: Fall only – even years

Advanced analyses in soil mechanics and their practical applications in foundation engineering; compressibility of soils, settlement analysis, and tolerable settlement; lateral earth pressures and design of earth retaining structures; bearing capacity of shallow foundations; in-situ soil testing for foundation design; design of deep foundations, including driven piles, drilled shaft foundations, and laterally loaded piles.

CE 271. Advanced Soil Mechanics and Foundation Engineering II. 3 Units
Prerequisite(s): CE 170 and CE 170L or equivalent.
Term Typically Offered: Fall only – odd years

Advanced analyses in shear strength of cohesionless and cohesive soils, including stress-strain characteristics of soils, total and effective stress analyses; slope stability analyses for natural slopes, fill slopes, earth dams, levees, and methods of slope stabilization; analysis and design of anchored bulkheads, cellular cofferdams, soil nail walls, tieback walls, mechanically stabilized earth walls, and segmental retaining walls.

CE 272. Geotechnical Modeling. 3 Units
Prerequisite(s): CE 170 and CE 170L or equivalent.
Term Typically Offered: Spring only – even years

Advanced analysis principles and procedures for calculating monotonic and cyclic soil element response effective stress and pore water pressure distributions, dynamic site response, and soil deformations; application to analysis of complex geotechnical engineering systems such as levees, dams, and wharfs. Laboratory time devoted to numerical analysis software and physical element and small scale tests. Lecture two hours. Laboratory three hours.

CE 273. Ground Modification Engineering. 3 Units
Prerequisite(s): CE 170 and CE 170L or equivalent.
Term Typically Offered: Fall, Spring

Principles of soil stabilization and earth reinforcement; mechanical compaction and treatment of difficult soils, including expansive soils, collapsible soils, oversize materials, and compressible fill; prefabricated vertical drains and preloading; dynamic deep compaction; vibro compaction; vibro-replacement; rammed aggregate pier; compaction grouting; jet grouting; slurry grouting; chemical grouting; deep soil mixing; slurry trench walls.

CE 274. Soil Dynamics and Earthquake Engineering. 3 Units
Prerequisite(s): CE 170 and CE 170L.
Term Typically Offered: Spring only – odd years

Introduction to vibration theory; wave propagation in soils and dynamic behavior of soils and foundations; dynamic tests; analysis of dynamically loaded foundations; causes of earthquakes; earthquake magnitude and zones; ground motions induced by earthquakes; earthquake-resistant design of foundations and earth dams.

CE 275. Geosynthetics. 3 Units
Prerequisite(s): CE 170 and CE 170L or equivalent.
Term Typically Offered: Fall only – even years

Overview of geotextiles, geogrids and geonets; geosynthetic properties and test methods; geosynthetic functions and mechanisms as in separation, roadway and soil reinforcement, filtration, and drainage; applications and design methods; construction, fabrication and installation.

CE 281. Systems Analysis of Resources Development. 3 Units
Prerequisite(s): Graduate status or instructor permission.
Term Typically Offered: Spring only – even years

Investigation of resource planning using the "systems approach". Objectives of resource development; basic economic and technologic concepts, and economic factors affecting system design. Consideration of evaluation, institutional constraints, and uncertainty in water resources systems. Familiarization with modern computer techniques. Applications of concepts to air and land resources.

CE 289. Project Management for Civil Engineers. 3 Units
Prerequisite(s): Graduate standing or instructor permission.
Term Typically Offered: Spring only

Theory and practice of project management in civil engineering. Interrelationship of planning, design, and construction. New technologies and techniques used in both US and international architectural/engineering/construction (A/E/C) markets.Topics: Project initiation, early estimates, project budgeting, work plans, design proposals, scheduling, tracking, design coordination, construction, project close-out, team and personal management skills, and quality control.

CE 296D. Stormwater Management. 3 Units
Prerequisite(s): CE 137 and CE 170
Term Typically Offered: Fall, Spring

Principles and practices of stormwater management. Physical and chemical principles affecting stormwater quality, environmental effects, and treatment. Regulatory purposes and requirements for managing construction and post-construction runoff. Choosing and designing Best Management Practices. Erosion control. Hydrologic and hydraulic design of small drainage systems. Emphasis on California climatic and regulatory conditions.

CE 296H. GIS Applications in Civil Engineering. 3 Units
Prerequisite(s): ENGR 115, CE 9 and CE 137 or CE 147 or CE 171A.
Term Typically Offered: Fall, Spring

Introduction to fundamental concepts of geographic information systems (GIS), methods, and applications in civil engineering. Design and develop GIS-based analytical methods and solutions for civil engineering problems. Lab exercises are used to design and practice GIS applications in civil engineering. This course may be paired with CE 196H.

CE 296J. Concrete Durability. 3 Units
Prerequisite(s): CE 183 or equivalent; CE 183 may be taken concurrently.
Term Typically Offered: Spring only – even years

Mass transport topics including surface absorption, hydraulic conductivity, diffusion, permeability. Mechanisms of concrete deterioration including alkali-aggregate reaction (AAR), sulfate attack, corrosion, carbonation, freeze-thaw damage, salt scaling, cracking, acid attack. Mitigation techniques, test methods and specifications. Introduction to service-life prediction and modeling.

CE 299. Special Problems. 1 - 3 Units
Term Typically Offered: Fall, Spring

Special problems in graduate research.
Note: Approval of a petition must be obtained from the faculty supervising the work and the Department Graduate Program Coordinator. Letter grade or Credit/No Credit.

Credit/No Credit

CE 500. Culminating Experience. 3 - 6 Units
Prerequisite(s): Advanced to candidacy and permission of the faculty advisor and Department Chair.
Term Typically Offered: Fall, Spring

Successful completion of either: A. Thesis (3-6 units), or B. Project (3-6 units) or C. Directed Study and Examination (3 units). Plan A requires a thesis and is primarily research-orientated. Plan B requires a project report that is primarily application oriented. Plan C requires a detailed literature review or experimental data analysis resulting in a written report plus an examination by three faculty. A public presentation is required for all three plans.