Civil Engineering
Jesus S. Larralde-Muro, *Coordinator*
Engineering East Building, Room 178
559.278.2889

Program Description

Civil engineering includes the research, development, planning, design, construction, and maintenance associated with urban development, water supply, structures, energy generation and transmission, water treatment and disposal, and transportation systems. The civil engineer deals with the function and safety of such public facilities as buildings, bridges, dams, pipelines, powerplants, highways, and harbors, and is concerned with the protection of the public against natural hazards of earthquakes, floods, landslides, and fires.

The graduate curriculum leading to an M.S. in Civil Engineering provides specialized training in the fields of structural engineering and applied mechanics, soil mechanics and foundation engineering, environmental engineering, water resources engineering, highway engineering, and geomatics engineering.

Career Opportunities

Employment opportunities for civil engineers in industry, state, and federal government agencies remain at a high level as a result of increasing urban growth and land development, and the recent emphasis on the maintenance and repair of the nationwide highway system. Civil engineers are also in demand to meet the growing challenge of mitigating environmental hazards.

Civil engineers frequently occupy positions in specialty areas such as environmental engineering, geotechnical engineering, structural engineering, transportation engineering, and water-resources engineering. Position titles for civil engineers, such as senior engineer or project engineer in specialty areas, typically reflect their rank within their organization.

Most civil engineering graduates have earned professional licenses as civil engineers within a few years of receiving their degrees.

Mission of Civil Engineering

The mission of the Civil Engineering Program is to provide the educational environment necessary for civil engineering students to develop their personal potential to the greatest extent possible and to enrich the students' lives in a culturally diverse environment. Civil engineering also provides the high quality education required for the students to fully develop their professional qualities and skills to serve society.

The Civil Engineering Program's Educational Objectives

- Offer a broadly based curriculum to civil engineering students, including general education as well as civil engineering education.
- Provide a civil engineering curriculum that includes an appropriate balance of engineering fundamentals and practical applications. Engineering fundamentals are covered mostly in the lower-division courses while the practical applications are strategically developed from the freshman through the senior levels.
- Provide the students with hands-on experience through laboratory courses, term projects, senior projects, and extra-curricular activities.
- Provide the students with the tools and skills required in professional practice and to make them aware of the necessity for a life-long learning approach in professional practice.
- Foster the development of sensitivity and awareness of the role of the professional civil engineer in society.
- Foster in the students the development of communication skills, responsibility, and dependability.
- Develop in the students the ability to effectively work in groups; multidisciplinary as well as multicultural groups.
- Develop in the students an understanding of the ethical, social, and political issues inherent in the civil engineering profession.

Bachelor of Science Degree Requirements

Civil Engineering Major — *Units*

Major requirements 61
CE 20, 85, 121L, 123, 123L, 128, 129, 130, 132, 142, 150, 180A, 180B ..... (31)
CE 124 or 142L ..... (1)
GME 15 ..... (3)
ECE 70 and 91 ..... (6)
IE 160 ..... (2)
ME 26, 112 ..... (6)

Technical Area Courses ..... (12)
Select mandatory technical area courses in one or more of the following groups subject to the *Design Courses* statement below.
Environmental and Water Resources: CE 140, 141, 143, 144
General Professional: CE 161, 190, 191T
Geotechnical: CE 125, 134
Structures: CE 131, 135, 136, 137, 138
Geomatics: GME 151, 173
Transportation: CE 151, 152, 153

Design Courses: at least 9 units of technical area courses must be selected from the following design courses: CE 125, 133, 134, 135, 136, 141, 143, 144, 151

Other requirements 63
General Education
Select one course from each of the G.E. areas: Area A1, A2, B2, C1, D1, D2, D3. (See pages 89-92 for G. E. listings.)
The following courses are required to satisfy both G.E. and major requirements: MATH 75 [B4], CHEM 3A [B1], PHIL 1 or 10 [C2], CE 121 [IB], PHIL 120 [IC], PLSI 120 [M/I]
Additional requirements
GEOL 1; MATH 76, 77,81; PHYS 4A, 4AL, 4B

Total 124

Note: Engineering majors are exempt from G.E. Area A3, third course Area C, Area E, and Area ID.

Advising Notes

1. Courses in mathematics, the physical sciences, or engineering taken ***CR/NC*** are not counted toward fulfillment of degree requirements in civil engineering.
2. The Upper-Division Writing Skills requirement can be met by passing the university examination or by completing IE 182W with a letter grade of ***C*** or better no sooner than the term in which 60 units of coursework are completed.
3. All civil engineering students must consult with their academic advisers at least once each year.

See the catalog Web Site for recommended program at *http://www.csufresno.edu/catoffice/current/engcivrec.html.*

Master of Science in Civil Engineering (MS-CE)

(See also *Admission to Graduate Standing, Advancement to Candidacy, Program Requirements*, and *Criteria for Thesis and Project.*)

Mission. Located in California's Central Valley, the M.S. in Civil Engineering (MSCE) Program offers a graduate program of excellence that provides opportunities for advanced education and research in civil and geomatics engineering. The program's mission is to offer a curriculum that combines preparation for professional practice as well as preparation for research and further advanced studies.

Admission. The requirements for graduate admission to California State University, Fresno must be met. Also, applicants should possess a bachelor's degree in civil engineering, geomatics engineering, or a related field from an institution accredited by the Accreditation Board for Engineering and Technology and must have a 2.7 grade point average in the last 60 semester-units of engineering courses attempted, on the basis of 4.0 being *A*, or the approval of the Graduate Committee of the Department of Civil and Geomatics Engineering. If an applicant's preparation is deemed insufficient by the Graduate Committee of the Department of Civil and Geomatics Engineering, the applicant is required to take additional courses which are specified in writing to remove the deficiency. Such courses, taken as an unclassified student, are in addition to the minimum of 30 semester hours credit for the master's degree in engineering. The department graduate program coordinator shall appoint an interim graduate adviser for each student when that student is accepted into the graduate program. The coordinator will take into account student interests and correlated faculty interests when making this appointment.

A student must satisfactorily complete a written examination administered by the department before being eligible for Advancement to Candidacy; this satisfies both the university's graduate writing requirement and demonstrates the student has sufficient technical proficiency to continue in the program.

Continuation in the Program. Prior to being admitted to classified standing, a student is required to take the Graduate Record Examination. The minimum grade considered passing is quantitative 450.

The student then should select a graduate adviser before completing 12 units of graduate study and advancing to candidacy. Other members of his or her graduate committee shall be selected in consultation with the graduate adviser if the student has selected Plan A. This committee shall consist of a total of three members, two of whom must be tenure/tenure track faculty. The graduate student shall notify the department's Graduate Committee with a letter signed by both the student and the graduate adviser of the membership of the students' Graduate Committee. This letter shall be placed in the student's academic folder.

A graduate student may change graduate advisers but such change must be approved by the department's Graduate Committee. The student, together with his or her graduate adviser, completes a contract program within his or her first semester of coursework taken for graduate credit. This program must be approved by the department's Graduate Committee. A minimum of 12 semester hours must be earned before the average is determined.

Campus graduate disqualification procedures shall be enforced by the department graduate program coordinator if the GPA drops below 3.0 (4.0 scale) each semester and cumulatively throughout all graduate program coursework. Any semester for which the grade point average falls below 3.0 shall result in placing the affected graduate student on probation. Normally, a second consecutive offense shall lead to disqualification. Such probation shall be for at least one semester or shall continue until the cumulative grade point average has again been raised above 3.0.

Program. Each master's degree student selects, as early as possible during the first semester of attendance, and upon consulting with and securing the approval of the graduate adviser, a program best suited to the student's interests and objectives.

The M.S. degree in Civil Engineering requires the completion of 30 units following one of three programs of study.

See the catalog Web site for civil engineering and geomatics engineering technical area courses that may be applied to the program at *http://www.csufresno.edu/catoffice/current/engcivprog.html.*

Plan A (Thesis)	*Units*
a. 200-series CE courses[1]	**12-24**
b. 100-series CE or GME technical area courses[2]	**0-6**
c. Courses outside the department[3]	**0-6**
d. Thesis	**6**
Total	**30**

Plan B (Project)	*Units*
a. 200-series CE courses[1]	**15-27**
b. 100-series CE or GME technical area courses[2]	**0-6**
c. Courses outside the department[3]	**0-6**
d. Project	**3**
Total	**30**

Plan C (Comprehensive Exam)	*Units*
a. 200-series CE courses[1]	**18-30**
b. 100-series CE or GME technical area courses[2]	**0-6**
c. Courses outside the department[3]	**0-6**
Total	**30**

Advising Notes

1. Graduate courses in civil engineering — select from CE 205, 206, 220, 230, 232, 233, 234, 235, 237, 240, 242, 245, 246A, 246B, 247, 251, 261, 271, 275, 280, 281, 283, 285, 286, 290, and 291T.
2. 100-series technical area courses in civil and geomatics engineering — select from CE 125, 131, 134, 135, 136, 137, 138, 141, 143, 144, 151, 153, 191T; GME 125, 126, 135, 140, 145, 152, 153, 161, 174, 175, 177, 191T; and ME 144.
3. 100-series and 200-series courses outside civil and geomatics engineering are in disciplines best suited to the students graduate program as approved by the program adviser. This includes mathematics, statistics, management, business, geology, physics, chemistry, health science, and biology.

COURSES

Civil Engineering (CE)

CE 20. Engineering Mechanics: Statics (3)
Prerequisites: MATH 77 or concurrently; PHYS 4A. Analysis of force systems, equilibrium problems, section properties; graphic, algebraic, and vector methods of problem solution. (CAN ENGR 8)

CE 29. Engineering Mechanics (3)
(See ME 29.)

CE 85. Introduction to Civil Engineering (3)
The civil engineering profession and its role in society; creative thinking and criti-

cal thinking as integral parts of the engineering decision process; engineering methods of analysis; problem solving; computer drafting; career opportunities. (Field trips required)

CE 110. Computer Applications in Civil Engineering (3)
Prerequisites: CE 85. Use and modification of existing programs. Creation of new programs. Use of structured language, spreadsheets, and numerical solutions CAD. Term projects.

CE 121. Mechanics of Materials (3)
Prerequisite: CE 20; CE 85 or concurrently. Applications of principles of mechanics to find stresses and deformations in machine and structural members.

CE 121L. Mechanics of Materials Laboratory (1)
Prerequisite: CE 121 or concurrently. Application of principles and methods of testing to verify theory and determine limitations of principles of mechanics of materials. (3 lab hours)

CE 123. Soil Engineering (3)
Prerequisites: CE 121. Physical and mechanical properties of soil as an engineering material; studies and design applications in permeability, one and two dimensional flows, seepage through earth dams and coffer dams, porewater pressure and excess porewater pressure; compressibility, stress-strain relationships and strength characteristics; computer-aided analysis case histories.

CE 123L. Soil Engineering Laboratory (1)
Prerequisite: CE 121L, 123 or concurrently. Experiments to illustrate and amplify the principles of soil mechanics. (3 lab hours; field trips required)

CE 124. Concrete Laboratory (1)
Prerequisite: CE 121L. Proportioning of concrete mixes; admixtures; workability tests; compressive, flexural, and tensile strength tests; reinforced concrete. (3 lab hours; field trips required)

CE 125. Geotechnical Engineering Design (3)
Prerequisites: CE 123. Design and theory of embankment and cut slopes, surcharging and sand drains, dewatering systems and ground control, excavation and support systems, field compaction and grouting systems; construction considerations, computer-aided design, and case histories. (2 lecture, 3 lab hours)

CE 127. Construction Soils and Foundation (3)
Not open to civil engineering majors. Prerequisite: upper-level standing. Physical and mechanical properties of soil, construction applications of soils engineering design, field control during construction, field problems and remedial measures, and case histories.

CE 127L. Construction Soil Lab (1)
Not open to civil engineering majors. Corequisite: CE 127. Laboratory experiments and sessions to reinforce principles of soil mechanics as well as foundation design and illustrate the use of soil as a construction material. (3 lab hours and field trips required)

CE 128. Civil Engineering Hydraulics (3)
Prerequisite: CE 20 or concurrently and CE 85 or concurrently. Fundamentals of civil engineering hydraulics with application to hydraulic structures.

CE 129. Engineering Hydraulics Lab (1)
Prerequisite: CE 128 or concurrently. Experiments and demonstrations in fluid properties, flow management, pipe flow, open channel flow, pumps, and hydraulic scour. (3 lab hours)

CE 130. Theory of Structures (3)
Prerequisite: CE 121. Trusses and frames analyzed by algebraic and graphic procedures; influence lines and live loading analysis; rigid frames analyzed by slope deflection and moment distribution. Introduction to matrix methods.

CE 131. Intermediate Theory of Structures (3)
Prerequisite: CE 130. Analysis of statically indeterminate beams, trusses, and frames; advanced topics in slope deflection and moment distribution; matrix methods.

CE 132. Reinforced Concrete Design (3)
Prerequisite: CE 130. Design of reinforced concrete structural elements using the Ultimate Strength Design Method. Introduction to the Alternate Method. Introduction to prestressed concrete. (2 lecture, 3 lab hours; field trips required)

CE 133. Design of Steel Structures (3)
Prerequisite: CE 130. Design of steel members and systems for buildings. Design areas include: tension members, compression members, beams, beam-columns, connections and plate girders. (2 lecture, 3 lab hours)

CE 134. Foundation Design (3)
Prerequisites: CE 123, 132 or concurrently. Design and theory of spread and continuous wall, rectangular, cantilever and trapezoidal footings; earth pressures and cantilever as well as gravity retaining walls; pile foundations; pile driving; construction considerations; load tests; subsurface investigations; case histories; and computer-aided design of foundations. (2 lecture, 3 lab hours)

CE 135. Reinforced and Prestressed Concrete Design (3)
Prerequisite: CE 132. Design of typical reinforced concrete and prestressed concrete structures. (2 lecture, 3 lab hours; field trips required)

CE 136. Design of Timber Structures (3)
Prerequisite: CE 130. Design of timber members and systems for buildings. Design areas include: loads, properties of wood, tension members, beams, columns, beam-columns, connections, diaphragms, shear walls, and glued laminated arches.

CE 137. Seismic Analysis of Building Structures (3)
Prerequisites: CE 130, ME 112. Effects of earthquakes on structures. Introduction to structural dynamics. Response of structures. Seismic provisions of building codes. Basic concepts in seismic-resistant design. Detailing for seismic-resistant construction. Term project. (Field trips required)

CE 138. Structural Mechanics (3)
Prerequisite: CE 130. Energy theorems and applications. Analysis of arches, beams on elastic foundations, cable stayed structures, and unsymmetrical bending of beams. Introduction to plastic theory of structures.

CE 140. Hydrology (3)
Prerequisites: CE 128 or concurrently. The hydrologic cycle, atmospheric conditions, precipitation, infiltration, ground water, soil moisture, evaporation, runoff, streamflow, hydrographs, flood routing, hydrologic statistical analysis; applications to water resources planning and management. (Field trips required)

CE 141. Water Resources Engineering (3)
Prerequisites: CE 128, 142 (or concurrently). Hydraulic design of water distribution, sewerage, and drainage systems. Computer-assisted pipe network analysis. Pump applications. (2 lecture, 3 lab hours; field trips required)

CE 142. Environmental Engineering (3)
Prerequisites: CHEM 1A or 3A concurrently; CE 128 or concurrently. Introduc-

tion to the principles and practices of environmental quality management, including water and air quality, waste management, and the environmental effects of engineered systems.

CE 142L. Environmental Quality Laboratory (1)
Prerequisite: CE 142 or concurrently. Study and analysis of physical, chemical, and biological characteristics of air, water, and solid wastes. (Field trips required)

CE 143. Engineering Hydraulics (3)
Prerequisite: CE 128. Design of pressure-conduit and open-channel flow systems with applications to hydraulic structures and control works, hydraulic power conversion, sediment transport, and channel stabilization.

CE 144. Design of Water Quality Control Processes (3)
Prerequisite: CE 142 or permission of instructor. Analysis and design of selected physical, chemical, and biological facilities for water purification and wastewater treatment. (2 lecture, 2 lab hours) (Field trips required)

CE 150. Transportation Planning and Design (3)
Prerequisite: GME 15, upper-division standing. Geometric design of land transportation facilities, primarily road/street systems. Traffic theory and analysis, including statistical analysis of traffic parameters. Freeway and intersection capacity. Simple transportation demand forecast. (2 lecture, 3 lab hours)

CE 151. Pavement Design (3)
Prerequisite: CE 123 or concurrently. Analysis of pavement structures. Factors affecting pavement performance. Structural design of flexible and rigid highway and airfield pavements. Pavement rehabilitation and repair.

CE 152. Transportation Engineering Materials (3)
Prerequisite: CE 123. Properties and durability of Portland cement concrete. Properties and testing of aggregates for asphalts concrete. Asphalt cements and asphalt concrete performance. Traditional and SUPERPAVE mix design and specification of asphalt concrete.

CE 153. Traffic Operations and Control (3)
Prerequisite: CE 150. Transportation studies. Highway traffic characteristics. Highway system traffic analysis. Highway system capacity design. Traffic regulations and control.

CE 161. Construction Engineering I (3)
Prerequisite: CE 123. Basics of civil engineering contracting, organization of construction firms, legal structures, project funding, cash flow, equipment costs, labor relations, and safety.

CE 170. Pollution and Society (3)
Prerequisite: PLSI 2 or 101. Not open to civil engineering majors. Descriptive analysis of natural and human environments. Effects of pollution and related human activities. Pollution control strategies and technology. Rational environmental decision-making. (Field trips required)

CE 180A. Project Design (2)
Prerequisites: senior standing in civil engineering; permission of instructor. Civil engineering practice, ethical issues, project analysis, and design. Student teams complete and orally defend proposal for a design project that includes several civil engineering specialties. Information gathering, time/resource management, and communication skills. (Formerly CE 191T)

CE 180B. Senior Project (2)
Prerequisites: CE 180A; approved project proposal; IE 182W (may be taken concurrently). Synthesis of previous coursework into a civil engineering design project under the supervision of a faculty member. Group projects except by special permission. (Formerly CE 180)

CE 185. Civil Engineering Practice (1)
Prerequisites: senior standing in civil engineering or permission of instructor; CE 180B concurrently. Practice of civil engineering; opportunities in civil engineering; transition from student to professional engineer; engineering ethics. Evaluation of design requirements, economic, and social considerations; student presentations.

CE 190. Independent Study (1-3; max total 6)
See *Academic Placement — Independent Study.* Approved for ***RP*** grading.

CE 191T. Topics in Civil Engineering (1-3; max total 6)
Prerequisite: permission of instructor. Investigation of selected civil engineering subjects not in current courses.

CE 193. Internship in Civil Engineering (2-4)
Prerequisite: permission of adviser. Engineering practice in a consulting, industrial, or government work setting. Each cooperative internship period usually spans a summer-fall or spring-summer interval. This course cannot be used to meet graduation requirements. ***CR/NC*** grading only.

GRADUATE COURSES

(See *Catalog Numbering System.*)

Civil Engineering (CE)

CE 205. Computing in Engineering Analysis (3)
Prerequisite: graduate status in engineering. Solution of engineering problems using digital computation. Modeling of engineering systems for numerical analysis.

CE 206. Engineering Environmental Impact (3)
Evaluation of environmental impacts due to engineering projects. The incorporation of environmental considerations into engineering design. Alternative solutions to engineering problems. Case histories of selected engineering projects.

CE 220. Advanced Foundation Engineering (3)
Prerequisite: graduate standing. Design of cantilevered and anchored sheet-pile walls; axial- and lateral-loaded pile groups; drilled piers; pile driving stresses and wave equation analysis; beams on elastic foundations; footings on expansive and non-uniform soils and on rock; and case histories.

CE 230. Advanced Theory of Structures (3)
Prerequisite: graduate standing in engineering or permission of instructor. Analysis of indeterminate structures by force (flexibility) methods and by displacement (stiffness) methods; Matrix methods suitable for digital computer solutions. Virtual work, real and complementary energy. Classical structural theorems. Introduction to the finite element method.

CE 232. Prestressed Concrete Design (3)
Prerequisite: graduate standing in engineering or permission of instructor. Structural behavior and design of prestressed concrete elements and systems — continuous beams, frames, slabs. Partial prestress. (Field trip[s] required)

CE 233. Advanced Behavior and Design of Steel Structures (3)
Prerequisite: graduate standing in engineering or permission of instructor. Material behavior and design of basic structural units; plate girders; connections; inelastic buckling; composite design; plastic design; P effect. Analysis and design of continuous structures, braced and unbraced frames; stability of steel structures. Critical study of the AISC specifications.

CE 234. Theory of Plates and Shells (3)
Prerequisite: graduate standing in engineering or permission of instructor. Methods of

calculating stresses and deformations in plates and shells used in engineering structures. Bending of circular and rectangular plates under various conditions. Membrane and flexural analysis of shells of revolution.

CE 235. Finite Element Analysis (3)
Prerequisite: graduate standing in engineering or permission of instructor. Theoretical and conceptual bases for formulation of finite element representations in solid mechanics. Development of element stiffness matrices for plane stress and plane strain problems, bending of plates and deformation of shells.

CE 237. Dynamics of Structures (3)
Analysis of structural members and systems subject to dynamic loads. Basic theory for single-degree-of-freedom and multi-degree-of-freedom analytical models; free vibration, harmonic and transient excitation, response spectrum, LaGrange's equations, earthquake analysis.

CE 240. Engineering Hydrology (3)
Prerequisites: CE 128, 140. Analysis of the physical and stochastic processes governing the occurrence and movement of water in its natural environment. Applications to hydraulic engineering practice.

CE 242. Water Resources Planning and Management (3)
Prerequisite: graduate standing in engineering or permission of instructor. A study of the interrelations of engineering, economic, legal, political, administrative, ecological, and social factors involved in the planning and management of water resources.

CE 246A. Advanced Water Quality (3)
Prerequisite: CE 142 or permission of instructor. Theory and practice of physical/chemical processes for controlling water quality, including chemical equilibrium and kinetics; mass transfer mechanisms; physical separation processes; adsorption, exchange, and membrane-based processes; disinfection.

CE 246B. Advanced Water Quality (3)
Prerequisites: CE 142 or permission of instructor; CE 246A recommended. Theory and practice of biological processes for controlling water quality, including suspended growth systems; attached growth systems; ponds; land treatment. Also sludge treatment processes, including biological stabilization, thickening, and dewatering; sludge disposal.

CE 247. Solid Wastes Engineering (3)
Planning and design of waste collection and disposal systems. Waste segregation and energy impact related to recovery and recycling practices. Environmental impact and institutional issues related to solid and hazardous waste systems.

CE 251. Advanced Boundary Law (3)
Prerequisite: GME 151 or equivalent. Land and water boundary legal issues, both historical and new. Case investigations.

CE 261. Geoprocessing (3)
Prerequisite: GME 173 or equivalent. Integration of computer technologies for gathering, analyzing, and displaying data associated with the earth's spatial features. Engineering design problems dependent on competing factors.

CE 271. Geodetic Systems Optimization (3)
Prerequisite: GME 108 or equivalent. National geodetic networks; planimetric and vertical control systems; geodetic control densification; network optimization criteria and methodology.

CE 275. Satellite Surveying (3)
Prerequisite: graduate standing. Discussion of GPS orbital theory, data collection and processing algorithms, network adjustments, project design and optimization techniques. Review of current research trends and applications. (Field trips required)

CE 280. Geomatics Engineering Seminar (1; max total 3)
Prerequisite: graduate standing. Current California State University, Fresno surveying engineering research presented and discussed by faculty and graduate students. Oral presentation and written report documenting ongoing research activities required.

CE 283. Digital Remote Sensing (3)
Prerequisite: GME 140 or equivalent. Quantitative approach in remote sensing; digital image characteristics, error correction, registration; geometric and radiometric image enhancement; image classification; system design; remote sensing and GIS.

CE 285. Advanced Analytical Photogrammetry (3)
Prerequisite: GME 125 or equivalent. Mathematical models in photogrammetry; bundle block adjustment, self-calibration; close-range photogrammetry; real time photogrammetry and data snooping. System design; hardware and software considerations in photogrammetry.

CE 286. Geographic Information Systems Design (3)
Prerequisite: GME 173 or equivalent. Data structures and algorithms, databases for GIS, error modeling and data uncertainty, visualization, data exchange and standards, the multipurpose cadaster, advanced analysis techniques.

CE 290. Independent Study (1-3; max total 6)
Prerequisite: graduate status in engineering. See *Academic Placement — Independent Study*. Approved for ***RP*** grading.

CE 291T. Topics in Engineering (1-3; max total 6)
Prerequisite: permission of instructor. Investigation of selected engineering topics. May be offered with a lab.

CE 298. Project (3; max total 3)
Prerequisite: graduate status in engineering. See *Criteria For Thesis and Project.* Independent investigation of advanced character such as analysis and/or design of special engineering systems or projects; critical review of state of the art of special topics, as the culminating requirement for the master's degree. Abstract required. Approved for ***RP*** grading.

CE 299. Thesis (2-6; max total 6)
Prerequisite: See *Criteria For Thesis and Project.* Preparation, completion, and submission of an acceptable thesis for master's degree. Approved for ***RP*** grading.

IN-SERVICE COURSES

(See *Catalog Numbering System.*)

Civil Engineering (CE)

CE 311. Professional Examination Review (2; may be repeated in different fields)
Prerequisite: bachelor's degree in engineering or eligibility to take state registration examinations. Review of engineering fundamentals for those qualified to take the state examination for certification as engineer-in-training; or review in a specific field (civil, electrical, mechanical, or other) for those preparing to take the examination for registration as professional engineer.

CE 321. Professional Engineering Seminar (1-3; may be repeated in different fields)
Prerequisite: bachelor's degree in engineering or related field, or experience as a professional engineer. Latest developments in various specialized areas of professional engineering practice; new materials, design and construction methods, equipment, devices, and procedures.