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 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 146. Urban Stormwater Management (3)
Prerequisites: CE 128, CE 140 (or concurrently). Overview of stormwater management; introduction to urban stormwater drainage system design. Covers stormwater management history and regulations, urban hydrology and hydraulic design, stormwater quality, receiving-water impacts, and best management practices. Computer-assisted analysis and design. (Field trips may be required.) (2 lecture, 3 lab hours)

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) **FS**

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 (2)
Prerequisite: CE 130, permission of the instructor. Basics of civil engineering contracting, project funding, cash flow, equipment costs, engineering economics. **FS**

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. **FS**

CE 180B. Senior Project (2)
Prerequisites: CE 180A; approved project proposal. Synthesis of previous coursework into a civil engineering design project under the supervision of a faculty member. Group projects except by special permission. **FS**

CE 185. Civil Engineering Practice (2)
Prerequisites: senior standing in civil engineering or permission of instructor. Practice of civil engineering; transition from student to professional engineer; engineering ethics; business and public policy; administration fundamentals; leadership.

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

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. **FS**

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. **F**

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. **S**

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; PΔ effect. Analysis and design of continuous structures, braced and unbraced frames; stability of steel structures. Critical study of the AISC specifications.

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