Civil Engineering
Administered by the Department of Civil, Construction and Environmental Engineering

Undergraduate Study
For undergraduate curriculum in civil engineering leading to the degree bachelor of science, see curriculum summaries below and also College of Engineering. This curriculum is accredited under the General Criteria and Civil Engineering Program Criteria by the Engineering Accreditation Commission of ABET, http://www.abet.org. Civil engineering consists of the application of the laws, forces, and materials of nature to the planning, design, construction, maintenance, and operation of public and private facilities, subject to economic, social, and environmental constraints. Commonly included are transportation systems; bridges and buildings; water supply, pollution control, waste management, irrigation, and drainage systems; river and harbor improvements; dams and reservoirs. Civil engineering also includes the planning, design, and responsible execution of surveying operations, and the location, delimitation, and delineation of physical and cultural features on the surface of the earth. Research, testing, sales, management, and related functions are also a part of civil engineering. Work on the campus is supplemented by inspection trips, which furnish an opportunity for firsthand study of engineering systems in operation, as well as projects under construction.

Environmental engineering, as a specialty area in civil engineering, is concerned with protecting the public and natural health; providing safe, palatable and ample water supply; management of solid and hazardous waste; proper treatment and disposal of domestic and industrial waste waters and waste; resource recovery; providing adequate drainage of urban and rural areas for sanitation; and the control of water quality, soil contamination, and air pollution. At the undergraduate level, the study of various environmental and water resource engineering topics is part of the course of study leading to the bachelor degree in civil engineering.

Program Goal
Consultation with an industrial advisory board of employers of civil engineers, with a broad base of civil engineering educators, and with students and alumni has yielded a continuous process of program planning, program assessment, curriculum development, and instructional development to produce an integrated, learning-based curriculum. The curriculum listed in this catalog has the academic program goal of developing an effective program that fulfills student educational needs and that equips and empowers qualified students for a successful career in civil or environmental engineering.

Program Educational Objectives
By three to five years after graduation, graduates of the civil engineering program will have:
1. Established themselves in successful careers in civil engineering or a related field.
2. Collaborated effectively on multi-disciplinary teams to address the needs of society and the environment.
3. Pursued lifelong learning, professional development, and registration as appropriate for their employers.

The faculty encourages the development of the student's professional skills through participation in cooperative education, internships, or progressive summer engineering employment. Qualified juniors and seniors interested in graduate studies may apply to the Graduate College to concurrently pursue the bachelor degree and a master of science in Civil Engineering, or a master of business administration in the College of Business Administration, giving the student the opportunity to graduate in five years with both degrees.

Graduate Study
The Department of Civil, Construction and Environmental Engineering offers work for the master of engineering, master of science, and doctor of philosophy degrees with a major in civil engineering with areas of specialization in structural engineering, environmental engineering, construction engineering and management, geotechnical engineering, civil engineering materials, and transportation engineering. The department also offers graduate minors of 9 to 15 credits of coursework to students from other engineering departments. Candidates for the degrees of master of engineering and master of science are required to satisfactorily complete a total of 30 credits of acceptable graduate work. The master of engineering degree involves all course work. The master of science degree requires the preparation of a thesis or creative component.

Candidates for the doctor of philosophy degree refer to the department’s home page and/or the department's Graduate Student Handbook for degree options and credit requirements. The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of engineering students at this university. However, because of the diversity of interests within the graduate programs in civil engineering, a student may qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering. Supporting work will be required depending upon the student's background and area of interest. A prospective graduate student is urged to specify the degree program and area of specialization in which he or she is interested on the application for admission. The department participates in the interdepartmental majors in transportation (master of science only), environmental science, and biorenewable resources and technology (see Index).

The Department of Civil, Construction and Environmental Engineering (CCEE Department) offers graduate certificates in construction management, environmental engineering, and environmental systems. The construction management certificate requires 12 credits, including nine credits of "core courses" and three credits of "elective courses" from approved CCEE Department lists.

For the environmental engineering and environmental systems certificates, each certificate requires the completion of four courses of three credits each and at least two of these courses shall be from an approved "core course" CCEE Department list and the remaining courses may be selected from an approved "elective courses" CCEE Department list. These courses are offered by different departments at Iowa State University. These two certificates also require the completion of a seminar course, C E 591 Seminar in Environmental Engineering, or any equivalent to be approved by the Environmental Engineering graduate faculty.

For additional requirements for these three certificates, refer to the document that describes each graduate certificate. These documents are available from the Department of Civil, Construction, and Environmental Engineering.

Curriculum in Civil Engineering (General)
Administered by the Department of Civil, Construction and Environmental Engineering.

Leading to the degree bachelor of science.

Total credits required: 128*. Any transfer credit courses applied to the degree program require a grade of C or better. See also Basic Program and Special Programs.

International Perspectives: 3 cr. ¹

U.S. Diversity: 3 cr. ¹

Communication Proficiency/Library requirement (minimum grade of C)

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication</td>
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</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition</td>
<td>3</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Information Literacy</td>
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Social Sciences and Humanities: 12 cr. ²

Complete 12 cr. with 6 cr. at 200-level or above.

Basic Program: 27 cr. ⁴

Complete with 2.00 GPA including transfer courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>CHEM 177</td>
<td>General Chemistry I</td>
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<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication (see above for grade requirements)</td>
<td>3</td>
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<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition (see above for grade requirements)</td>
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<tr>
<td>ENGR 101</td>
<td>Engineering Orientation</td>
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<tr>
<td>C E 160</td>
<td>Engineering Problems with Computational Laboratory</td>
<td>³ 3</td>
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<td>LIB 160</td>
<td>Information Literacy</td>
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<tr>
<td>MATH 165</td>
<td>Calculus I</td>
<td>4</td>
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<tr>
<td>MATH 166</td>
<td>Calculus II</td>
<td>4</td>
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¹ Includes 1 cr. approved foreign language course.
² Includes social science courses.
³ Includes 3 cr. approved foreign language course.
⁴ Includes 3 cr. approved foreign language course.
Curriculum in Civil Engineering with Environmental Option

Administered by the Department of Civil, Construction and Environmental Engineering.

Leading to the degree bachelor of science.

Total credits required: 129. Any transfer credit courses applied to the degree program require a grade of C or better. See also Basic Program and Special Programs.

International Perspectives: 3 cr.

U.S. Diversity: 3 cr.

Communication Proficiency/Library requirement (minimum grade of C):

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<td>ENGL 150</td>
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<tr>
<td>LIB 160</td>
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Social Sciences and Humanities: 12 cr.

Complete 12 cr. with 6 cr. at 200-level or above.

Basic Program: 27 cr.

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Math and Physical Science: 26 cr.

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<td>BIOL 173</td>
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<td>CHEM 231</td>
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<td>CHEM 231L</td>
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<td>GEOL 201</td>
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<td>MATH 266</td>
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<td>MICRO 201</td>
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Statistics Elective 2

Numerical Analysis Elective 2

Total Credits 26

C E/Env Engineering Core: 27 cr.

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<tbody>
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</tbody>
</table>

Statistics Elective 2

Numerical Analysis Elective 2

Total Credits 26
Courses primarily for undergraduates:

**C E 101. Technical Lecture.**
Cr. R. F.S.
(1-0) Discussion of various phases of civil engineering. For transfer students only. Evaluation of transfer credits and discussion of graduation requirements. Offered on a satisfactory-fail basis only.

**C E 105. Introduction to the Civil Engineering Profession.**
(1-0) Cr. 1. F.S.
Overview of the nature and scope of the civil engineering profession. Exploration of the various specialty areas within civil engineering. Bloom's Taxonomy and creativity. Departmental rules, student services operations, degree requirements, educational objectives, program of study planning, career options, and student organizations.

**C E 111. Fundamentals of Surveying I.**
(2-3) Cr. 3. F.S. Prereq: C E 160, credit or enrollment in ENGR 170 or C E 170, MATH 165, credit or enrollment in C E 105 for C E majors

**C E 120. Civil Engineering Learning Community.**
Cr. R. Repeatable.
Integration of first-year students into the Civil Engineering program. Assignments and activities involving teamwork, academic preparation, study skills, and preparation for entry into the Civil Engineering profession. Completed both individually and in learning teams under the direction of faculty and peer mentors. Offered on a satisfactory-fail basis only.

**C E 160. Engineering Problems with Computational Laboratory.**
(2-2) Cr. 3. F.S. Prereq: MATH 141, MATH 142 or satisfactory scores on mathematics placement assessments; credit or enrollment in MATH 165
Formulation of engineering problems using spreadsheets and Visual Basic for Application for solution. Presenting results using word processing, tables, and graphs. Introduction to engineering economics and statics. Civil engineering examples.

**C E 170. Graphics for Civil Engineering.**
(0-4) Cr. 2. F.S. Prereq: MATH 165, credit or enrollment in C E 105
Fundamental graphics. Introduction to computer aided drafting and modeling. Civil engineering applications.

**C E 206. Engineering Economic Analysis and Professional Issues in Civil Engineering.**
(3-0) Cr. 3. F.S. Prereq: MATH 166, ENGL 250; ECON 101 recommended
Engineering/managerial analysis of the economic aspects of project proposals. Alternative sources of funds; time value of money; expenditure of capital funds and methods of evaluating alternative projects. Professionalism, licensure, liability, ethics, leadership, social responsibility, creative and critical thinking, and applications/impacts of regulations in civil engineering.

**C E 298. Cooperative Education.**
Cr. R. F.S.S. Prereq: Permission of department and Engineering Career Services
First professional work period in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

**C E 306. Project Management for Civil Engineers.**
(2-3) Cr. 3. F.S. Prereq: C E 206, Credit or enrollment in a technical communication elective from the approved department list
Project management, including work breakdown structures, cost estimating, scheduling, and project control. Civil engineering project life cycle, including planning, design, construction, and maintenance processes. Techniques in interpretation of contract documents, plan reading, and in estimating quantities.

**C E 326. Principles of Environmental Engineering.**
(2-2) Cr. 3. F.S. Prereq: CHEM 177 or CHEM 178, MATH 166, credit or enrollment in E M 378
Introduction to environmental problems, water quality indicators and requirements, potable water quality and quantity objectives, water sources and treatment methods; water pollution control objectives and treatment methods; survey of solid and hazardous waste management and air pollution control. Nonmajor graduate credit.

**C E 332. Structural Analysis I.**
(2-2) Cr. 3. F.S. Prereq: E M 324
AISC design methods for structural steel buildings. Load and Resistance Factor Design. Theoretical behavior and applications. Analysis and design of structural steel members subject to tension, compression, flexure, and combined axial force and bending. Analysis and design of bolted and welded connections. Nonmajor graduate credit.

Total Credits 37

**Technical Communication Elective**

**Total Credits**

3

**Seminar/Co-op/Internships: R cr.**

C E 403 Program and Outcome Assessment R

Co-op/Internship optional.

Notes.

1. These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.

2. Choose from department approved list.

3. See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

4. 2.00 required including transfer courses.

5. Students who transfer in with CHEM 167 General Chemistry for Engineering Students/CHEM 167L Laboratory in General Chemistry for Engineering will be able to take CHEM 178 General Chemistry II/CHEM 178L Laboratory in College Chemistry II to complete the program's Chemistry requirement.

See also: A 4-year plan of study grid showing course template by semester for Civil Engineering—General Program. (https://nextcatalog.registrar.iastate.edu/planofstudy/engineering/civilengineringbs-generalprogram)

See also: A 4-year plan of study grid showing course template by semester for Civil Engineering—Environmental Specialization. (https://nextcatalog.registrar.iastate.edu/planofstudy/engineering/#civilengineeringbs-environmentalspecialization)

Other Remaining Courses: 37 cr.

**C E 105. Introduction to the Civil Engineering Profession.**
(1-0) Cr. 1. F.S.
Overview of the nature and scope of the civil engineering profession. Exploration of the various specialty areas within civil engineering. Bloom’s Taxonomy and creativity. Departmental rules, student services operations, degree requirements, educational objectives, program of study planning, career options, and student organizations.

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(2-3) Cr. 3. F.S. Prereq: C E 160, credit or enrollment in ENGR 170 or C E 170, MATH 165, credit or enrollment in C E 105 for C E majors

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Cr. R. Repeatable.
Integration of first-year students into the Civil Engineering program. Assignments and activities involving teamwork, academic preparation, study skills, and preparation for entry into the Civil Engineering profession. Completed both individually and in learning teams under the direction of faculty and peer mentors. Offered on a satisfactory-fail basis only.

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Engineering/managerial analysis of the economic aspects of project proposals. Alternative sources of funds; time value of money; expenditure of capital funds and methods of evaluating alternative projects. Professionalism, licensure, liability, ethics, leadership, social responsibility, creative and critical thinking, and applications/impacts of regulations in civil engineering.

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First professional work period in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

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(2-3) Cr. 3. F.S. Prereq: C E 206, Credit or enrollment in a technical communication elective from the approved department list
Project management, including work breakdown structures, cost estimating, scheduling, and project control. Civil engineering project life cycle, including planning, design, construction, and maintenance processes. Techniques in interpretation of contract documents, plan reading, and in estimating quantities.

**C E 326. Principles of Environmental Engineering.**
(2-2) Cr. 3. F.S. Prereq: CHEM 177 or CHEM 178, MATH 166, credit or enrollment in E M 378
Introduction to environmental problems, water quality indicators and requirements, potable water quality and quantity objectives, water sources and treatment methods; water pollution control objectives and treatment methods; survey of solid and hazardous waste management and air pollution control. Nonmajor graduate credit.

**C E 332. Structural Analysis I.**
(2-2) Cr. 3. F.S. Prereq: E M 324
AISC design methods for structural steel buildings. Load and Resistance Factor Design. Theoretical behavior and applications. Analysis and design of structural steel members subject to tension, compression, flexure, and combined axial force and bending. Analysis and design of bolted and welded connections. Nonmajor graduate credit.
C E 334. Reinforced Concrete Design I.
(2-2) Cr. 3. F.S. Prereq: C E 332, E M 327
Analysis and design of beams, one-way slabs, and columns. Preliminary design of building frames using pattern loading and moment coefficients. Nonmajor graduate credit.

C E 350. Introduction to Transportation Planning.
(3-0) Cr. 3. S. Prereq: 3 credits in statistics, junior classification
An introductory course for planning urban and regional transportation systems within government. Applications and impacts of legislation, financing, four-step planning process, population trends, land use, societal impacts, public transportation, master plans and traffic impact studies. Organization and coordination of the transportation planning function. Nonmajor graduate credit. Not available for graduation credit for students in civil engineering.

(3-0) Cr. 3. F.S. Prereq: C E 111, C E 206, PHYS 221, a course in statistics from the approved departmental list
Introduction to planning and operations of transportation facilities. Vehicle/operation/infrastructure characteristics. Technological, economic and environmental factors. Travel demand modeling and capacity analysis. Nonmajor graduate credit.

C E 360. Geotechnical Engineering.
(2-3) Cr. 3. F.S. Prereq: E M 324, credit or enrollment in GEOL 201
Introduction to soil engineering and testing. Identification and classification tests, soil water systems, principles of settlement, stresses in soils, and shear strength testing; slope stability, retaining walls, bearing capacity. Nonmajor graduate credit.

(3-0) Cr. 3. F.S. Prereq: E M 378, a course in statistics from the approved departmental list
The hydrologic cycle: precipitation, infiltration, runoff, evapotranspiration, groundwater, and streamflow. Hydrograph analysis, flood routing, frequency analysis and urban hydrology. Applied hydraulics including pipe and channel flow with design applications in culverts, pumping, water distribution, storm and sanitary sewer systems. Design project required. Nonmajor graduate credit.

C E 382. Design of Concretes.
(2-3) Cr. 3. F.S. Prereq: Credit or enrollment in C E 360
Physical and chemical properties of bituminous, portland, and other cements; aggregate properties and blending; mix design and testing of concretes; admixtures, mixing, handling, placing and curing; principles of pavement thickness design. Nonmajor graduate credit.

C E 383. Design of Portland Cement Concrete.
(0-2) Cr. 1. F.S. Prereq: Credit or enrollment in C E 360
For Con E students only. Physical and chemical properties of portland cement and p.c. concrete. Mix design and testing of p.c. concrete.

C E 388. Sustainable Engineering and International Development.
(Cross-listed with A E, E E, M E, MAT E, BSE). (2-2) Cr. 3. F. Prereq: Junior classification in engineering
Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernmental organizations (NGOs). Course readings, final project/design report. Meets International Perspectives Requirement.

C E 396. Summer Internship.
Cr. R. Repeatable. SS. Prereq: Permission of department and Engineering Career Services, completion of two terms in residence in civil engineering, employment in civil engineering or related field
Summer professional work period. Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only.

C E 397. Engineering Internship.
Cr. R. Repeatable. F.S. Prereq: Permission of department and Engineering Career Services
One semester maximum per academic year professional work period. Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only.

C E 398. Cooperative Education.
Cr. R. F.S.SS. Prereq: C E 298, permission of department and Engineering Career Services
Second professional work period in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

C E 403. Program and Outcome Assessment.
Cr. R. F.S. Prereq: Verification of undergraduate application for graduation by the end of the first week of class. Permission of instructor for students who are scheduled for summer graduation
Assessment of C E Curriculum and educational objectives. Assessments to be reviewed by the CE Department to incorporate potential improvements. Offered on a satisfactory-fail basis only.

C E 411. Bioprocessing and Bioproducts.
(Dual-listed with C E 511). (Cross-listed with A E, BIOE, BSE). (3-0) Cr. 3. F.
Prereq: E A 216, C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification

C E 417. Land Surveying.
(2-3) Cr. 3. S. Prereq: C E 111
Legal principles affecting the determination of land boundaries, public domain survey systems. Locating sequential and simultaneous conveyances. Record research, plat preparation, and land description. Study of selected court cases. Nonmajor graduate credit.

(Dual-listed with C E 520). (2-3) Cr. 3. F.
Prereq: C E 326, CHEM 177 and CHEM 178, MATH 166
Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions, and mass transfer principles. Individual laboratory practicals and group projects required.

C E 421. Environmental Biotechnology.
(Dual-listed with C E 521). (2-2) Cr. 3. F.
Prereq: C E 326
Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens, parasites, and disinfection.

C E 424. Air Pollution.
(Dual-listed with C E 524). (Cross-listed with ENSCI, A E). (1-0) Cr. 1.
Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 424A. Air Pollution: Air quality and effects of pollutants.
(Dual-listed with C E 524A). (Cross-listed with ENSCI, A E). (1-0) Cr. 1.
Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 424B. Air Pollution: Climate change and causes.
(Dual-listed with C E 524B). (Cross-listed with ENSCI, A E). (1-0) Cr. 1.
Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 424C. Air Pollution: Transportation constraints.
(Dual-listed with C E 524C). (Cross-listed with ENSCI, A E). (1-0) Cr. 1.
Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.
C E 424E. Air Pollution: Agricultural sources of pollution. (Dual-listed with C E 520E). (Cross-listed with ENSCI, A E). (1-0) Cr. 1. Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above
1 cr. per module. Module A prerequisite for all modules; module B prerequisite for D and E.

C E 428. Water and Wastewater Treatment Plant Design. (2-2) Cr. 3. S. Prereq: C E 326 Physical, chemical and biological processes for the treatment of water and wastewater including coagulation and flocculation, sedimentation, filtration, adsorption, chemical oxidation/disinfection, fixed film and suspended growth biological processes and sludge management.


C E 483. Pavement Analysis and Design. (Dual-listed with C E 583). (3-0) Cr. 3. Prereq: C E 360 and C E 382 Analysis, behavior, performance, and structural design of pavement systems. Topics include climate factors, rehabilitation, life cycle design economics, material and system response, pavement foundations and traffic loadings. Development of models for and analysis of pavement systems. Use of transfer functions relating pavement response to pavement performance. Evaluation and application of current and evolving pavement design practices and procedures. Mechanistic-based pavement design techniques and concepts. Analysis of the effects of maintenance activities on pavement performance and economic evaluation of pavement systems. Nonmajor graduate credit.


C E 485. Civil Engineering Design. (2-2) Cr. 3. F.S. Prereq: C E 306, C E 326, C E 333 or C E 334, C E 355, SP CM 212 The civil engineering design process, interacting with the client, identification of the engineering problems, development of a technical proposal, identification of design criteria, cost estimating, planning and scheduling, codes and standards, development of feasible alternatives, selection of best alternative, and oral presentation.


C E 498. Cooperative Education. Cr. R. Repeatable. F.S.SS. Prereq: C E 398, permission of department and Engineering Career Services Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

C E 501. Preconstruction Project Engineering and Management. (3-0) Cr. 3. Prereq: CON E 221 and CON E 421 Application of engineering and management control techniques to construction project development from conceptualization to notice to proceed. Determinants of construction project success, conceptual estimating, design and engineering planning for automated construction techniques, constructability review procedures, planning for safety, value engineering.

C E 502. Construction Project Engineering and Management. (3-0) Cr. 3. Prereq: CON E 221 and CON E 421 Application of engineering and management control techniques to construction projects. Construction project control techniques, equipment selection and utilization, project administration, construction process simulation, Quality Management, and productivity improvement programs.

C E 503. Construction Management Functions and Processes. (3-0) Cr. 3. Prereq: CON E 421 Analysis of critical construction management skills. Analysis of organizational systems related to construction management. Case studies. Analysis of theories of motivation, planning, leadership, organizational change, etc., as they relate to field construction operations.

C E 506. Case Histories in Construction Documents. (3-0) Cr. 3. Prereq: CON E 221, credit or enrollment in CON E 421
Study of cases involving disputes, claims, and responsibilities encountered by management in construction contract documents. Analysis of methods of resolving differences among the owner, architect, engineer, and construction contractor for a project.

C E 510. Information Technologies for Construction. (3-0) Cr. 3. Prereq: CON E 421, ENGR 160 or C E 160 or equivalent
Information technologies including microcomputer based systems, management information systems, automation technologies, computer-aided design, and expert systems and their application in the construction industry. Overview of systems acquisition, communications, and networking.

C E 511. Bioprocessing and Bioproducts. (Dual-listed with C E 411). (Cross-listed with A E, BIOE, BSE) (3-0) Cr. 3. F.
Prereq: A E 216, C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification

C E 515. Railroad Engineering. (3-0) Cr. 3. Alt. S., offered 2014. Prereq: C E 355

C E 520. Environmental Engineering Chemistry. (Dual-listed with C E 420). (2-3) Cr. 3. Prereq: CHEM 177 and CHEM 178, MATH 166
Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions and mass transfer principles. Individual laboratory practicals and group projects required. Term paper and oral presentation for graduate level only.

C E 521. Environmental Biotechnology. (Dual-listed with C E 421). (2-2) Cr. 3. Prereq: C E 326
Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, biorenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Term paper and oral presentation.

C E 522. Water Pollution Control Processes. (Cross-listed with ENSCI), (2-2) Cr. 3. Prereq: C E 521
Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems.

C E 523. Physical-Chemical Treatment Process. (Cross-listed with ENSCI), (2-2) Cr. 3. Prereq: C E 520
Material and energy balances. Principles and design of physical-chemical unit processes; including screening, coagulation, flocculation, chemical precipitation, sedimentation, filtration, lime softening and stabilization, oxidation, adsorption, membrane processes, ion exchange and disinfection; recovery of resources from residuals and sludges; laboratory exercises and demonstrations; case studies in mineral processing and secondary industries.

C E 524. Air Pollution. (Dual-listed with C E 424). (Cross-listed with ENSCI, A E), (1-0) Cr. 1. Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 524A. Air Pollution: Air quality and effects of pollutants. (Dual-listed with C E 424A). (Cross-listed with ENSCI, A E), (1-0) Cr. 1. Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 524B. Air Pollution: Climate change and causes. (Dual-listed with C E 424B). (Cross-listed with ENSCI, A E), (1-0) Cr. 1. Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 524C. Air Pollution: Transportation constraints. (Dual-listed with C E 424C). (Cross-listed with ENSCI, A E), (1-0) Cr. 1. Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 524D. Air Pollution: Off-gas treatment technology. (Dual-listed with C E 424D). (Cross-listed with ENSCI, A E), (1-0) Cr. 1. Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 524E. Air Pollution: Agricultural sources of pollution. (Dual-listed with C E 424E). (Cross-listed with ENSCI, A E), (1-0) Cr. 1. Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.
Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 527. Solid Waste Management. (Cross-listed with ENSCI). (3-0) Cr. 3. Prereq: C E 326
Planning and design of solid waste management systems; includes characterization and collection of domestic, commercial, and industrial solid wastes, waste minimization and recycling, energy and materials recovery, composting, incineration, and landfill design.

C E 529. Hazardous Waste Management. (Cross-listed with ENSCI). (3-0) Cr. 3. Prereq: C E 326
Regulatory requirements for the classification, transport, storage and treatment of hazardous wastes. Analysis and design of alternatives for treatment and disposal technologies, including physical, chemical, and biological treatment, solidification, incineration, and secure landfill design. Regulatory requirements and procedures for hazardous waste contaminated site investigations and risk analysis. Analysis and design of remedial action alternatives for site restoration.

C E 532. Structural Analysis II. (3-0) Cr. 3. F. Prereq: C E 332
Analysis of indeterminate structural problems by the force and generalized direct displacement methods. Direct stiffness method for 2-D frames, grids, 3-D frames. Additional topics for the stiffness method.

C E 533. Structural Steel Design II. (3-0) Cr. 3. Prereq: C E 333

C E 534. Reinforced Concrete Design II. (2-2) Cr. 3. Prereq: C E 334
Every third semester, offered F 2013. Design of reinforced concrete long columns, floor slabs, building frames, isolated footings and combined footings. Design and behavior considerations for torsion, biaxial bending, structural joints and shear friction. Introduction to cold-formed composite steel and composite floor slab design.

C E 535. Prestressed Concrete Structures. (3-0) Cr. 3. Prereq: C E 334
Every third semester, offered S 2014. Design of prestressed concrete structures, review of hardware, stress calculations, prestress losses, section proportioning, flexural design, shear design, deflections, statically indeterminate structures.

C E 536. Masonry and Timber Design. (Dual-listed with C E 436), (2-2) Cr. 3. Alt. F., offered 2013. Prereq: C E 334
Behavior and design of clay and concrete masonry beams, columns, walls, and structural systems. Behavior and design of timber and laminated timber beams, columns, connections, and structural systems. Two additional design problems.

C E 541. Dynamic Analysis of Structures. (3-0) Cr. 3. Alt. S., offered 2015. Prereq: E M 345 and credit or enrollment in C E 532
C E 542. Structural Analysis by Finite Elements. 
(3-0) Cr. 3. S. Prereq: C E 532  

C E 545. Seismic Design. 
(3-0) Cr. 3. Alt. F., offered 2013. Prereq: C E 333, C E 334  

C E 546. Bridge Design. 
(Dual-listed with C E 448). (2-2) Cr. 3. Alt. S., offered 2015. Prereq: C E 333, C E 334  
Bridge design in structural steel and reinforced concrete. Application of AASHTO Bridge Design Specifications. Analysis techniques for complex structures. Preliminary designs include investigating alternative structural systems and materials. Final designs include preparation of design calculations and sketches. Nonmajor graduate credit.

C E 547. Analysis and Design of Plate and Slab Structures. 
(3-0) Cr. 3. Alt. S., offered 2015. Prereq: C E 334, E M 514, MATH 266  
Bending and buckling of thin plate components in structures utilizing classical and energy methods. Analysis of shear flows by membrane and bending theories.

C E 548. Building Design. 
(Dual-listed with C E 448). (2-2) Cr. 3. Alt. S., offered 2014. Prereq: C E 333, C E 334  

(Dual-listed with C E 451). (2-2) Cr. 3. F. Prereq: C E 350 or C E 355  
Urban transportation planning context and process. Project planning and programming. Congestion, mitigation, and air quality issues. Transportation data sources. Travel demand and network modeling. Use of popular travel demand software and applications of geographic information systems. Term project required for graduate credit.

(3-0) Cr. 3. Prereq: C E 355  
Engineering aspects of highway traffic safety. Reduction of accident incidence and severity through highway design and traffic control. Accident analysis. Legal implications. Safety in highway design, maintenance, and operation.

C E 553. Traffic Engineering. 
(2-2) Cr. 3. Prereq: C E 355  
Driver, pedestrian, and vehicular characteristics. Traffic characteristics; highway capacity; traffic studies and analyses. Principles of traffic control for improved highway traffic service. Application of intersection, corridor or network analysis computer evaluation and optimization tools.

C E 556. Transportation Data Analysis. 
(3-0) Cr. 3. Prereq: C E 355, STAT 101 or STAT 105  
Analysis of transportation data, identification of data sources and limitations. Static and dynamic data elements such as infrastructure characteristics, flow and operations-related data elements. Spatial and temporal extents data for planning, design, operations, and management of transportation systems. Summarizing, analyzing, modeling, and interpreting data. Use of information technologies for highways, transit, and aviation systems.

C E 557. Transportation Systems Analysis. 
(3-0) Cr. 3. Prereq: C E 355, 3 credits in statistics or probability  
Travel studies and analysis of data. Travel projections. Public transportation forecasts and analyses. Statewide, regional, and local transportation system planning. Corridor travel planning. Optimization of systems.

C E 558. Transportation Systems Development and Management Laboratory. 
(2-2) Cr. 3. Prereq: C E 350 or C E 355  
Study of designated problems in traffic engineering, urban transportation planning, and urban development. Forecasting and evaluation of social, economic, and environmental impact of proposed solutions; considerations of alternatives. Formulation of recommendations and publication of a report. Presentation of recommendations in the host community.

C E 559. Transportation Infrastructure/Asset Management. 
(3-0) Cr. 3. Prereq: C E 355 or C E 453, C E 382  
Engineering management techniques for maintaining and managing infrastructure assets. Systematic approach to management through value engineering, engineering economics, and life cycle cost analysis. Selection and scheduling of maintenance activities. Analysis of network-wide resource needs. Project level analysis.

(3-0) Cr. 3. Prereq: C E 360  
Limiting stress analysis, stress paths, introduction to critical state soil mechanics, constitutive models, soil strength under various drainage conditions, seepage, pore pressure parameters, consolidation, slope stability and retaining wall applications.

(2-3) Cr. 3. Prereq: C E 460  
Lateral earth pressure theories and retaining structures. Field investigations, in-situ testing, foundations on expansive soils, and analysis and design of shallow and deep foundations. Foundation engineering reports.

C E 562. Site Evaluations for Civil Engineering Projects. 
(2-2) Cr. 3. Prereq: C E 360  
Identification and mapping of engineering soils from airphotos. Use of remote sensing and GIS, planning subsurface investigations, geomatics prospecting, water resource applications.

C E 563. Experimental Methods in Geotechnics. 
(1-4) Cr. 3. Prereq: C E 360  
Principles of geo-engineering laboratory testing including the conduct, analysis, and interpretation of soil classification tests, compaction tests, permeability tests, consolidation, triaxial, direct and ring shear tests. Issues regarding laboratory testing versus field testing and acquisition, transport, storage, and preparation of samples for geotechnical testing. Field and laboratory geotechnical monitoring techniques, including the measurements of deformation, strain, total stress and pore water pressure.

C E 564. Application of Numerical Methods to Geotechnical Design. 
(3-0) Cr. 3. Prereq: C E 560  
Application of numerical methods to analysis and design of foundations, underground structures, and soil-structure interaction. Application of slope stability software. Layered soils, bearing capacity and settlement for complex geometries, wave equation for piles, and foundation vibrations.

(2-3) Cr. 3. Prereq: C E 365  
Atoms and molecules, crystal chemistry, clay minerals, structure of solids, phase transformations and phase equilibria. Surfaces and interfacial phenomena, colloid chemistry, mechanical properties. Applications to soils and civil engineering materials. Overview of state-of-the-art instrumental techniques for analysis of the physicochemical properties of soils and civil engineering materials.

C E 567. Geomaterials Stabilization. 
(Dual-listed with C E 467). (2-2) Cr. 3. Prereq: C E 565  
Soil and aggregate physical and chemical stabilization procedures. Soil stabilization analysis and design. Ground modification methods. Geosynthetics application and design. A term project is required.

C E 568. Dynamics of Soils and Foundations. 
(3-0) Cr. 3. F. Prereq: C E 360, E M 345  

C E 570. Applied Hydraulic Design. 
(2-2) Cr. 3. Prereq: C E 372  
Flow characteristics in natural and constructed channels; principles of hydraulic design of culverts, bridge waterway openings, spillways, hydraulic gates and gated structures, pumping stations, and miscellaneous water control structures; pipe networks, mathematical modeling. Design project.

C E 571. Surface Water Hydrology. 
(Cross-listed with ENSCI). (3-0) Cr. 3. Prereq: C E 372  
Analysis of hydrologic data including precipitation, infiltration, evapotranspiration, direct runoff and streamflow; theory and use of frequency analysis; theory of streamflow and reservoir routing; use of deterministic and statistical hydrologic models. Fundamentals of surface water quality modeling, point and non-point sources of contamination. Design project.
C E 572. Analysis and Modeling Aquatic Environments.
(Cross-listed with ENSCI). (3-0) Cr. 3. Prereq: C E 372
Principles of surface water flows and mixing. Introduction to hydrologic transport and water quality simulation in natural water systems. Advection, diffusion and dispersion, chemical and biologic kinetics, and water quality dynamics. Applications to temperature, dissolved oxygen, primary productivity, and other water quality problems in rivers, lakes and reservoirs. Deterministic vs. stochastic models.

(Dual-listed with C E 473). (3-0) Cr. 3. Prereq: C E 372

(3-0) Cr. 3. Prereq: E M 378 or equivalent
Analysis and applications of flows in civil engineering, environmental engineering, and water resources. Primary topics include conservation laws, laminar flow, turbulence, mixing, diffusion, dispersion, water waves, and boundary layers. Associated applications include particle settling, transfer at air-water and water-sediment boundaries, flow and friction in pipes and open channels, contaminant transport, waves in lakes, jets, plumes, and salt wedges.

Cr. R. Repeatable. Prereq: Graduate classification
(1-0) Students and outside/invited speakers give weekly presentations about the ongoing research work and Geotechnical and Materials Engineering issues. Offered on a satisfactory-fail basis only.

C E 583. Pavement Analysis and Design.
(Dual-listed with C E 483). (3-0) Cr. 3. Prereq: C E 360 and C E 382
Analysis, behavior, performance, and structural design of pavement systems. Topics include climate factors, rehabilitation, life cycle design economics, material and system response, pavement foundations and traffic loadings. Development of models for and analysis of pavement systems. Use of transfer functions relating pavement response to pavement performance. Evaluation and application of current and evolving pavement design practices and procedures. Mechanistic-based pavement design techniques and concepts. Analysis of the effects of maintenance activities on pavement performance and economic evaluation of pavement systems.

C E 584. Advanced Design of Concretes.
(Dual-listed with C E 484). (2-2) Cr. 3. F. Prereq: C E 382
Asphalt binder characterization, fundamentals of asphalt rheology, asphalt materials behavior under loading and temperature effects. Portland cement concrete admixtures, cements and admixture compatibility, environmental effects on concrete performance, advanced performance testing. A term project is required.

(2-3) Cr. 3. Prereq: C E 382

(2-3) Cr. 3. Prereq: C E 382 or C E 383
Hydraulic cements, aggregates, admixtures, and mix design; concrete production, quality control, early-age properties and durability. Concrete distress examination, identification, prevention, and nondestructive testing; advanced concrete technology, high-strength and high performance concrete.

C E 590. Special Topics.
Cr. 1-5. Repeatable. F.S.S.
Pre-enrollment contract required.

C E 591. Seminar in Environmental Engineering.
Cr. R. Repeatable. F.S. Prereq: Graduate classification
(1-0) Contemporary environmental engineering issues. Outside speakers. Review of ongoing research in environmental engineering. Offered on a satisfactory-fail basis only.

C E 594. Special Topics in Construction Engineering and Management.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594A. Special Topics Construction Engineering and Mgt.: Planning and Scheduling.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594B. Special Topics Construction Engineering and Mgt.: Computer Applications for Planning and Scheduling.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594C. Special Topics Construction Engineering and Mgt.: Cost Estimating.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594E. Special Topics Construction Engineering and Mgt.: Project Controls.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594F. Special Topics Construction Engineering and Mgt.: Computer Applications for Project Controls.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594G. Special Topics Construction Engr and Mgt: Integration of Planning, Scheduling and Project Controls.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594H. Special Topics Construction Engineering and Mgt.: Trenchless Technologies.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594I. Special Topics Construction Engineering and Mgt.: Electrical and Mechanical Construction.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594J. Special Topics Construction Engineering and Mgt.: Advanced Building Construction Topics.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:
C E 594M. Special Topics Construction Engineering and Mgt.: Design Build Construction.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594N. Special Topics Construction Engineering and Mgt.: Industrial Construction.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594O. Special Topics Construction Engineering and Mgt.: Highway and Heavy Construction.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594P. Special Topics Construction Engineering and Mgt.: Advanced Technologies.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594Q. Special Topics Construction Engineering and Mgt.: Construction Quality Control.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594R. Special Topics Construction Engineering and Mgt.: Risk Management.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

C E 594S. Special Topics Construction Engineering and Mgt.: Building Information Modeling.
Cr. 1-3. Repeatable. Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor
Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:

(0-1) Cr. 1. Prereq: Credit or enrollment in C E 501, C E 502, C E 503, or C E 505
Assigned readings and reports on research methods to solve construction engineering and management problems such as robotics, project controls, automation, etc. Identification of research methods and priorities, selection and development of research design, and critique of research in construction engineering and management.

C E 596. Special Topics in Transportation Engineering.
Cr. arr. Repeatable. Prereq: C E 355

C E 596A. Special Topics in Transportation Engineering: Intelligent Transportation Systems.
Cr. arr. Repeatable. Prereq: C E 355

C E 596B. Special Topics in Transportation Engineering: Geographic Information Systems in Transportation.
Cr. arr. Repeatable. Prereq: C E 355

Cr. arr. Repeatable. Prereq: C E 355

C E 596D. Special Topics in Transportation Engineering: Transportation and Public Works.
Cr. arr. Repeatable. Prereq: C E 355

C E 596E. Special Topics in Transportation Engineering: Sustainable Transportation.
Cr. arr. Repeatable. Prereq: C E 355

C E 596F. Special Topics in Transportation Engineering: Freight Transportation.
Cr. arr. Repeatable. Prereq: C E 355

C E 599. Creative Component.
Cr. 1-3. Repeatable.
Pre-enrollment contract required. Advanced topic for creative component report in lieu of thesis.

Courses for graduate students:

C E 622. Advanced Topics in Environmental Engineering.
(2-0) Cr. 2. Repeatable. Prereq: Permission of environmental engineering graduate faculty
Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:

C E 622A. Advanced Topics in Environmental Engineering: Water Pollution Control.
(2-0) Cr. 2. Repeatable. Prereq: Permission of environmental engineering graduate faculty
Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:

C E 622B. Advanced Topics in Environmental Engineering: Water Treatment.
(2-0) Cr. 2. Repeatable. Prereq: Permission of environmental engineering graduate faculty
Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:

C E 622C. Advanced Topics in Environmental Engineering: Solid and Hazardous Waste.
(2-0) Cr. 2. Repeatable. Prereq: Permission of environmental engineering graduate faculty
Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:

C E 622D. Advanced Topics in Environmental Engineering: Water Resources.
(2-0) Cr. 2. Repeatable. Prereq: Permission of environmental engineering graduate faculty
Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:

C E 650. Advanced Topics in Transportation Engineering.
(3-0) Cr. 3. Repeatable. Prereq: Permission of Transportation Engineering graduate faculty

C E 650A. Advanced Topics in Transportation Engineering: Highway Design.
(3-0) Cr. 3. Repeatable. Prereq: Permission of Transportation Engineering graduate faculty

(3-0) Cr. 3. Repeatable. Prereq: Permission of Transportation Engineering graduate faculty

C E 690. Advanced Topics.
Cr. 1-3. Repeatable. F.S.S.S.
Pre-enrollment contract required.

C E 697. Engineering Internship.
Cr. R. Repeatable. Prereq: Permission of coop advisor, graduate classification
One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

C E 699. Research.
Cr. 1-30. Repeatable. Prereq: Pre-enrollment contract required