

Fall 2020 Course Descriptions as of 04/05/2020 08:10 PM

Information in Browse Course Catalog is subject to change. Information is term specific. Please refer to the appropriate term when searching for course content. Key to Course Descriptions may be found at: http://rcs.registrar.arizona.edu/course_descriptions_key.

Civil Engineering (CE)

CE 102A: Introduction to Civil Engineering Lecture Series - Micro Campus (1 unit)

Description: This course is designed to give students an introduction of civil engineering. Students will attend a series of 50-minute lectures. Lecture topics will include contemporary technical challenges in civil engineering, engineering ethics and engineering teamwork. Students will complete a Career Plan, which involves preparation of a resume and development of an academic plan. Students will attend some field trips to the construction and/or civil engineering related sites.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered: Distance Campus: Fall, Spring

Field trip: None

CE 194: Practicum (1 - 3 units)

Description: The practical application, on an individual basis, of previously studied theory and the collection of data for future theoretical interpretation.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 199: Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 210: Engineering Graphics (1 unit)

Description: Representations and analysis of systems of orthographic projection and graphical methods used in engineering design and production, correlated with technical sketching.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$73

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall

CE 214: Statics (3 units)

Description: Equilibrium of a particle, equivalent and resultant force systems, equilibrium, geometric properties of areas and solids, trusses, frames and machines, shear force and bending moments, friction. Honors section is available.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Discussion Required
 Lecture Required

Course typically offered:

Main Campus: Fall, Spring, Summer

Distance Campus: Fall, Spring

Enrollment requirement: (PHYS 141 or PHYS161H) and (MATH 129 or MATH 250B or concurrently enrolled in MATH 250B.)

CE 215: Mechanics of Solids (3 units)

Description: Material behavior; relationship between external forces acting on elastic and inelastic bodies and the resulting behavior; stress and deformation of bars, beams, shafts, pressure vessels; stress and strain; combined stresses; columns. Honors section is available.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Discussion Required
 Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Distance Campus: Fall, Spring

Enrollment requirement: CE 214.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 218: Mechanics of Fluids (3 units)

Description: Hydrostatics, continuity, irrotational flow, pressure distributions, weirs and gates, momentum and energy, surface drag, pipe friction, form drag, pipe fitting losses.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	Required
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring

Distance Campus: Fall, Spring

Enrollment requirement: CE 214 or ENGR 211C(Environmental Engineering majors only).

CE 251: Elementary Surveying (3 units)

Description: Theory of measurements and errors; vertical and horizontal control methods; topographic, public land and construction surveys; use of surveying instruments.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$40

Course Components:	Laboratory	May Be Offered
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: MATH 111.

CE 260: Computer Programing in Civil Engineering (1 unit)

Description: This 1 unit course is designed to give students a basic knowledge of MATLAB programming. The course will cover fundamentals of MATLAB operations with arrays (vectors and matrices), it will discuss how to create script files, function files, use loop and conditional statements and present the computed results graphically. Students will be required to write simple programs in MATLAB.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Enrollment requirement: MATH 223

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 293: Internship (1 - 3 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 294: Practicum (1 - 3 units)

Description: The practical application, on an individual basis, of previously studied theory and the collection of data for future theoretical interpretation.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 299: Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 299H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 301: Engineering Communications (3 units)

Description: Elements of written and oral communications for engineers including technical writing skills for proposal and report preparation, delivery techniques for oral presentations, and the effective use of audio/visual aids.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	Required
	Lecture	Required

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Enrollment requirement: Adv Stdg: Engineering.

CE 303: Numerical Analysis for Civil Engineers (3 units)

Description: Finding Roots of Nonlinear Equations, Solution Techniques for System of Linear Equations, Curve Fitting - Polynomial and Spline Interpolation, Least Squares Fit, Numerical Differentiation and Integration, Solution of Ordinary Differential Equations - Initial and Boundary Value Problems; Use of MATLAB codes in Numerical Analysis for solving Civil Engineering Problems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Recommendations and additional information: MATH 254.

Enrollment requirement: Pre-requisites: Math 254, CE 260 and ENGR advance standing

CE 310: Probability and Statistics in Civil Engineering (3 units)

Description: Statistical decision theory and its application in civil engineering. Identification and modeling of non-deterministic problems in civil engineering and the treatment thereof relative to engineering design and decision making. Statistical reliability concepts.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Enrollment requirement: Adv Standing: Engineering. MATH 129.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 323: Hydraulic Engineering and Design (4 units)

Description: Open channel flow, natural streams and waterways, hydrologic analysis and design, pressure flow, analysis and design of pipe networks and pump systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Laboratory	May Be Offered
	Lecture	Required

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Recommendations and additional information: C E 218.

Enrollment requirement: Adv Standing: Engineering. CE 218.

CE 329: Fluid Mechanics Laboratory (1 unit)

Description: Open-channel and closed conduit studies of basic flow phenomena, with emphasis on continuity, conservation of momentum, and exchange of energy; calibration of flow-measuring devices.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Laboratory	Required
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Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Concurrent registration, CE 218.

Enrollment requirement: Adv Stdg: Engineering.

CE 333: Elementary Structural Analysis (3 units)

Description: Analysis of Structures: beams, frames and trusses. Statically determinate structures; influence lines; deflections by the virtual work method. Statically indeterminate structures using the superposition method.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Enrollment requirement: Adv Standing: Engineering. CE 215.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 334: Structural Design in Steel (3 units)

Description: Design of steel members, connections and simple structures, introduction to load and resistance factor design concept, including tension members, laterally supported and unsupported beams, columns, bolted and welded connections.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Enrollment requirement: Adv Standing: Engineering. CE 333.

CE 335: Structural Design in Concrete (3 units)

Description: Analysis and design of reinforced concrete members subjected to flexure, shear and axial loads; deflection of beams; bond and development of reinforcement.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Enrollment requirement: Adv Standing: Engineering. CE 333.

CE 343: Soil Mechanics (3 units)

Description: In this course, we will discuss the fundamental physical and mechanical properties of soils and use them in the design of simple foundation and earth retaining systems. We will use certain fundamental principles of solid mechanics and fluid mechanics to describe the mechanical behavior of soils.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Enrollment requirement: Adv Standing: Engineering. CE 215.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 349: Soils Laboratory (1 unit)

Description: Conduct and interpret soil test results. Test include water content, particle size, permeability, consolidation and shear strength.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$20

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Concurrent registration, CE 343.

Enrollment requirement: Adv Stdg: Engineering.

CE 363: Transport Engineering and Pavement Design (4 units)

Description: Basis for planning, design, and operation of transportation facilities. Driver and vehicle performance characteristics, highway geometric and pavement design principles; traffic analysis and transportation planning.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Enrollment requirement: Adv Stdg: Engineering.

CE 370L: Environmental and Water Engineering Laboratory (1 unit)

Description: The course is supplementary to CHEE/CE 370R, the three-unit introductory environmental engineering course. Basically, it consists of a 1-unit, problem-oriented lab that meets two hours per week to provide supplementary material for non chemical engineers taking the introductory course. Emphasis will be on introducing chemistry and biochemistry concepts that support environmental engineering operations for water and wastewater treatment. Basic problem solving skills in these areas will also be developed.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Laboratory Required

Equivalent to: CE 370L

Also offered as: CHEE 370L

Course typically offered:

Main Campus: Spring

Recommendations and additional information: Not open to Chemical Engineering students.

Home department: Chemical & Environmental Engineering

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 370R: Environmental and Water Engineering (3 units)

Description: Covers principles and methods for analysis of environmental engineering issues. Includes such topics as greenhouse gas effects, tropospheric air pollution, environmental air pollution, environmental risk assessment, surface and ground water pollution and drinking and wastewater treatment.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 370, CE 370R, CHE 370, CHEE 370

Also offered as: CHEE 370R

Course typically offered:

Main Campus: Spring

Recommendations and additional information: CHEE 201 and (CHEM 241A or CHEM 242A or CHEM 246A) and (CHEM 243A or CHEM 247A) or Engineering Advanced Standing.

Home department: Chemical & Environmental Engineering

Enrollment requirement: (CHEE 201 and (CHEM 241A or CHEM 242A or CHEM 246A) and (CHEM 243A or CHEM 247A)) or Advanced Standing.

Special Exam: Special Exam Credit Only

CE 381: Construction Engineering Management (3 units)

Description: Provide an opportunity to develop an enhanced understanding of construction industry and practices in preparation to contribute to construction firms, project management consultants, and owners upon graduation and to improve project delivery by understanding linkages between design and construction

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Discussion Required
 Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Distance Campus: Fall, Spring

Recommendations and additional information: Advance Standing.

Field trip: To construction sites.

Enrollment requirement: Adv Standing: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 389: Materials Testing Laboratory (1 unit)

Description: Selected testing of steel, concrete, wood, and bituminous materials according to standard test procedures.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$47

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 215.

CE 393: Internship (1 - 3 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

Student Engagement Activity: Professional Development

Student Engagement Competency: Professionalism

CE 399: Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 399H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering. Honors active.

Honors Course: Honors Course

Honors Course: Honors Course

CE 402: Introduction to Finite Element Methods (3 units)

Description: Theory and formulation procedures: energy and residual. One-dimensional problems: stress analysis in axial structures, steady and transient fluid and heat flow, consolidation, wave-propagation, beam-column. Two-dimensional problems: field and plane/axisymmetric, use of computer codes for solution to typical problems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: EM 402

Co-convened with: CE 502

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 303.

CE 408A: Issues in Civil Engineering Practice (3 units)

Description: Introduction to non-technical issues impacting the practice of design professionals in the private and public sectors including: types of organizations; income, expenses, and profit; quality-based selection for obtaining and performing work; contracts; dispute resolution methods; professional ethics.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Standing: Engineering. Prerequisite or concurrent enrollment in CE 301. At least two of the following: CE 323, (CE 334 or CE 335), CE 343, CE 363, (CE 370R or CE 381).

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 408B: Civil Engineering Senior Capstone Design (3 units)

Description: A culminating experience for majors involving a substantive project that demonstrates a synthesis of learning accumulated in the major, including broadly comprehensive knowledge of the discipline and its methodologies. Senior standing required.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	May Be Offered
	Lecture	Required

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Standing: Engineering. CE 301, CE 408A, and at least 4 of the following courses: CE 323, (CE 334 or CE 335), CE 343, CE 363, (CE 370R or CE 381).

Student Engagement Activity: Discovery

Student Engagement Competency: Innovation and Creativity

CE 410: Probability in Civil Engineering (3 units)

Description: [Usually offered every third semester beginning Fall 2001] Outlines the extent of uncertainties under which civil engineering designs and decisions are made. Theory and application. Advanced topics in risk-based engineering design. System reliability concepts. Statistical decision theory and its application in civil engineering. Identifying and modeling, nondeterministic problems in engineering in understanding many recently issued engineering codes.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Co-convened with: CE 510

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. MATH 129, CE 310.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 422: Open-Channel Flow (3 units)

Description: [Usually offered every three semesters beginning Fall 2007] Differential equations governing unsteady flow in open channels. Simple surface waves in subcritical and supercritical flows. Introduction of kinematic, diffusion, and dynamic wave methods. Applications to reservoir routing, dam break flow, and overland flow.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: ABE 422

Also offered as: BE 422

Co-convened with: CE 522

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 323 or consent of instructor.

Enrollment requirement: Adv Standing: Engineering. CE 323 or consent of instructor.

CE 423: Hydrology (3 units)

Description: Discussion and analysis of major topics of the hydrologic cycle and their interrelationship, such as rainfall, infiltration, evaporation, and runoff. Statistical and probabilistic methods in water supply and flood hydrology.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: HWRS 423, HYDR 423

Also offered as: ATMO 423, HWRS 423

Co-convened with: CE 523

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Standing: Engineering. CE 218.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 424: Sedimentation Engineering (3 units)

Description: Sediment transport is an engineering science that addresses the movement and transportation of solid granular particles in open channel flows. It deals with the hydrodynamics of sediment-laden flow and the mechanism of sediment motion in the particle-liquid two-phase flow. The first part of this course aims to provide an introduction of fundamental principles governing flow and sediment transport and apply these principles to solve practical problems such as designing stable channel, estimating flow resistance, quantifying sediment load. The second part is river mechanics that examines river dynamics and bank stability and introduces basic engineering measures to cost-effective maintain river stability and prevent flooding.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 524

Course typically offered:

Main Campus: Fall, Spring

Field trip: None

Enrollment requirement: CE 218 and Advance Standing: Engineering and consent of Instructor.

CE 426: Watershed Engineering (3 units)

Description: Design of waterways, erosion control structures and small dams. Methods for frequency analysis and synthetic time distribution of rainfall. Methods for estimating infiltration and runoff from small watersheds, flow routing and storm water management. Estimating erosion using the Revised Universal Soil Loss Equation.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 426, WSM 426

Also offered as: BE 426, WSM 426

Co-convened with: CE 526

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Home department: Biosystems Engineering

Enrollment requirement: Adv. Stdg: Engineering or WSM major or minor. CE 218 or AME 331.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 427: Computer Applications in Hydraulics (3 units)

Description: Computer modeling of surface water hydrology, flood plain hydraulics and water distribution systems. Theoretical basis. Application and design studies.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: ABE 427, HWRS 427

Also offered as: BE 427, HWRS 427

Co-convened with: CE 527

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Standing: Engineering. CE 323 or consent of instructor.

CE 429: Special Topics in Hydraulics & Water Resources Engineering (3 units)

Description: Selected advanced topics will be covered in the fields of hydraulics and water resources engineering with emphasis on analysis and design of water systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Repeatable: Course can be repeated for a maximum of 9 units.

Co-convened with: CE 529

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Consent of instructor.

Enrollment requirement: Adv Stdg: Engineering.

Honors Course: Honors Contract

Honors Course: Honors Contract

CE 432: Advanced Structural Design in Steel (3 units)

Description: Advanced problems in the analysis and design of steel structures including beam columns, plate girders, composite construction, multi-story buildings; static and dynamic lateral and vertical loads; connections; computer applications.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 532

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 334.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 433: Advanced Structural Analysis (3 units)

Description: [Usually offered every other Spring beginning 2002] Analysis of Structures: beams, frames and trusses. Statically indeterminate structures with stiffness methods: slope-deflection and moment distribution. Energy methods. Matrix structural analysis and computer applications. Qualitative influence lines and approximate solutions of statically indeterminate structures.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 333.

CE 434: Design of Wood and Masonry Structures (3 units)

Description: [Usually offered every third semester beginning Spring 2002] Determination of gravity and lateral loads on structures. Design of wood structures for axial load and bending; structural wood panels, diaphragms and shear walls. Types of masonry construction. Design of masonry structures for gravity and lateral loads.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 534

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. Prerequisite or concurrent registration in CE 333.

CE 435: Prestressed Concrete Structures (3 units)

Description: Behavior, analysis and design of statically determinate and indeterminate prestressed concrete structures; calculation of loss of prestress. Usually offered every other Spring beginning 2003.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 535

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 333, CE 335.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 437: Advanced Structural Design in Concrete (3 units)

Description: [Usually offered every other Spring beginning 2002] Advanced problems in the analysis and design of concrete structures, design of slender columns and one- and two-way slabs; lateral and vertical load analysis of bridges and multistory buildings; introduction to design for torsion and seismic forces; use of structural computer programs.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 537

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 333, CE 335.

CE 438: Behavior and Design of Structural Systems (3 units)

Description: Structural systems, gravity load resisting systems, lateral force resisting systems, tall building design, computer structural analysis, structural steel, reinforced concrete, building codes, seismic resistant design.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 538

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Standing: Engineering. CE 333 and CE 334. CE 335 not required but strongly recommended.

CE 440: Foundation Engineering (3 units)

Description: Settlement and bearing capacity of shallow and deep foundations; beam on elastic foundation; design of footings and pile foundations; foundations on metastable soils; the use of computer codes for foundation problems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 540

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Standing: Engineering. CE 343.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 441: Earth Structures in Geotechnical Engineering (3 units)

Description: Stability analysis for earth slopes, including planar, circular piecewise-linear, and composite-surface methods; analyses for static and steady-flow conditions; earth pressure theories and calculations for generalized conditions; design of rigid and flexible retaining structures; design of braced and tie-back shoring systems; design of reinforced earth walls; computer-aided analysis and design.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 541

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 343.

CE 442: Ground Improvement (3 units)

Description: This course will talk about different ground improvement techniques including those without addition of materials, by adding materials and using reinforcing elements. During the course, opportunities will be given to students to develop a range of generic skills including written communication skills, problem solving skills and analysis and critical evaluation skills. Upon successful completion of this course, the student will be able to - Understand the principles, applications, and design procedures for various ground improvement techniques. Use analytical/theoretical/numerical calculations to assess the effectiveness of a ground improvement technique. Gain competence in properly evaluating alternative solutions, and the effectiveness before, during and after using ground improvement.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 542

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 343. Consent of instructor.

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 444: Special Topics In Geomechanics (3 units)

Description: Introduction to geoenvironmental engineering; physiochemical and microstructural behavior of geomaterials, effect of pollutants, design of waste disposal systems; advanced laboratory testing, geotextiles, space geomechanics, etc. Usually offered every third semester starting Spring 2003.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 544

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 343.

CE 445: Geoenvironmental Engineering (3 units)

Description: Waste generation and disposal regulations; types and characterization of wastes, engineering properties of soil-water-contaminants; use of earth and geosynthetic materials in waste containment applications; evaluation, design and construction of liner and leachate collection systems used in landfills and heap leach mining; remediation of contaminated sites. Usually offered every third semester beginning Fall 2002.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 545

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 343.

CE 446: Geotechnical Earthquake Engineering (3 units)

Description: Review of plate tectonics and seismology, analysis of earthquake ground motions, travel path and distance effects, and site response effects. Soil liquefaction susceptibility, identification, and mitigation. Introduction to seismic slope stability.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: GEN 446

Also offered as: GEN 446

Co-convened with: CE 546

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 343.

Honors Course: Honors Contract

Honors Course: Honors Contract

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 448: Numerical Methods in Geotechnical Engineering (3 units)

Description: Brief statements and applications of numerical methods based on closed-form solutions, finite difference and finite element methods for problems involving soil structure interaction such as piles, retaining walls, group piles, underground works; seepage; and consolidation.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 548

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 343, CE 402.

CE 449: Statistical Hydrology (3 units)

Description: Application of statistics and probability to uncertainty in the description, measurement, and analysis of hydrologic variables and processes, including extreme events, error models, simulation, sampling.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 449, HWR 445

Also offered as: HWRS 449

Co-convened with: CE 549

Course typically offered:

Main Campus: Fall

Recommendations and additional information: SIE 305 or MATH 461 or equivalent calculus-based probability/statistics course.

Home department: Hydrology and Atmospheric Sciences

CE 455: Soil and Water Resources Engineering (3 units)

Description: Introduction to soil and water relationships, irrigation systems, irrigation water supply, and irrigation management; basic designs.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 455

Also offered as: BE 455

Co-convened with: CE 555

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Home department: Biosystems Engineering

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status. CE 218 or AME 331.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 456: Irrigation Systems Design (3 units)

Description: Design and operation of surface, sprinkler, and trickle irrigation systems based on economic and environmental criteria.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 456

Also offered as: BE 456

Co-convened with: CE 556

Course typically offered:

Main Campus: Spring (odd years only)

Distance Campus: Spring (odd years only)

Field trip: Field trip.

Home department: Biosystems Engineering

Enrollment requirement: Adv. Stdg: Engineering. CE 218.

CE 458: Soils, Wetlands and Wastewater Reuse (3 units)

Description: Water quality and system design for agricultural drainage and waste-water systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 458

Also offered as: BE 458

Co-convened with: CE 558

Course typically offered:

Main Campus: Spring (even years only)

Distance Campus: Spring (even years only)

Home department: Biosystems Engineering

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status. CE 218 or AME 331.

CE 460: Special Topics in Transportation Engineering (3 units)

Description: Selected advanced topics will be covered in the field of transportation engineering, with emphasis on analysis and design of transportation systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:

Repeatable: Course can be repeated for a maximum of 9 units.

Co-convened with: CE 560

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 363 or equivalent or consent of instructor.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 462: Traffic Engineering and Operations (3 units)

Description: Two-thirds of urban vehicle-miles of travel in the U.S. are on signal-controlled roadways. Traffic control systems are designed and installed to achieve two primary goals -- safety and efficiency -- by providing orderly movement in all directions. However, present traffic control systems are by no means a perfect solution for delay or crash problems on urban roads. A poorly designed traffic control system can have a negative impact on traffic operations by lengthening vehicle delay, increasing the rate of vehicle crashes, and introducing disruptions to traffic progression. On a national average, poor signal timing causes up to fifteen percent excess vehicle delay, sixteen percent excess vehicle stops, seven percent excess travel time, and nine percent excess fuel consumption. A previous study reported that there are roughly 300,000 traffic signals in the U.S. and about 75 percent of them could be improved easily and inexpensively. This indicates that huge benefits are potentially obtainable through traffic control system optimizations. In recent years, traffic detectors have been intensively deployed in major highway systems across the country. These sensors generate tremendous traffic data that are extremely valuable for traffic management, forecast, and control. How to manage the data efficiently and produce the most useful information out of them have been crucial challenges faced by traffic professionals. Therefore, this course introduces important concepts and principles of traffic system design, geometric characteristics, and operation of streets and highways, including planning aspects, traffic design and control, and highway safety. Simulation modeling and application of these concepts and principles to actual situations will be emphasized to evaluate traffic system performance.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Co-convened with: CE 562

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Departments allowed to enroll will be CE, SE, IE, EM, CEEM, and Planning majors or permission from the instructor.

Enrollment requirement: CE 363 and Adv Stdg: Engineering.

CE 462A: Public Transit Planning and Operations (3 units)

Description: [Taught odd-numbered years] Development, operation, management, financing, evaluation and travel demand estimation for urban public transportation systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Equivalent to: PLG 462A

Also offered as: PLG 462A

Co-convened with: CE 562A

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 463: Traffic Flow and Capacity Analysis (3 units)

Description: Methods for the efficient and safe operation of transport facilities through analysis of capacity, safety, speed, parking, and volume data. Usually offered every third semester beginning Fall 2001.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 563

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 363.

CE 464A: Integrated Highway Bridge Design Using LRFD Methodology (3 units)

Description: Methods for the integrated design of components typically found in transportation structures including bridge super- and sub-structures, retaining walls, pavements, highway geometrics, traffic, drainage, etc. Taught by practicing engineers.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 564A

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Standing: Engineering. CE 310, CE 323, CE 343, and CE 363. Concurrent registration, CE 335.

CE 465: Transportation Data Management and Analysis (3 units)

Description: This course introduces important concepts of database design and application. Popular database and analytical tools are introduced and demonstrated using traffic sensor data, roadway geometric data, and traffic accident data. The objective is to introduce modern concepts, algorithms, and tools for transportation data management and analysis. With the instructions, assignments, and projects in this course, students are expected to learn database design theories; analytical methods for capacity, safety, and time series analyses; and skills on popular software tools for transportation data management and analysis.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 565

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv. Standing: Engineering. CE 363.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 466: Highway Geometric Design (3 units)

Description: Study of geometric elements of streets and highways, with emphasis on analysis and design for safety. Offered every third semester.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$25

Course Components:	Lecture	Required
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Co-convened with: CE 566

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 363.

CE 467: Traffic Safety (3 units)

Description: The following course is intended to introduce topics in traffic safety. Included will be information on how to understand and utilize crash data, safety analysis methods described in the Highway Safety Manual, statistical methods in safety analysis, human factors and crash causality, and an overview of other emerging safety issues and resources.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:

Co-convened with: CE 567

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Standing: Engineering. CE 363 or equivalent or consent of instructor.

CE 468: Urban Transportation Planning (3 units)

Description: Transportation planning in relation to urban development; techniques and procedures for developing long-range regional plans. Usually offered every third semester beginning Fall 2002.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 468, PLAN 468, PLN 468, PLNG 468

Also offered as: PLG 468

Co-convened with:

Course typically offered:

Main Campus: Fall

Home department: Planning

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 469: Travel Demand Modeling (3 units)

Description: Detailed investigation of methods to model travel demand, covering data collection and analysis, model development, and forecasting applications.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 569

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Standing: Engineering. CE 363.

CE 473: Biodegradation of Hazardous Organic Compounds (3 units)

Description: To learn and integrate the basic principles of microbiology required for understanding of application of bioremediation to contaminated sites. To become familiar with current research in bioremediation. To learn to solve problems often encountered in application of bioremediation.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Equivalent to: CE 473

Also offered as: CHEE 473

Co-convened with: CE 573

Course typically offered:

Main Campus: Spring

Home department: Chemical & Environmental Engineering

Enrollment requirement: Adv Stdg: Engineering.

CE 476A: Water Treatment System Design (3 units)

Description: Application of theory and engineering experience to the design of unit operations for the production of potable water. Covers water regulations, conventional treatment technologies and selected advanced treatment topics.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 476A

Also offered as: CHEE 476A

Co-convened with: CE 576A

Course typically offered:

Main Campus: Fall

Recommendations and additional information: Recommend that Civil Engineering students take CE 370R and CE 370L prior to enrolling in CE 476A.

Home department: Chemical & Environmental Engineering

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 482: Construction Project Planning, Scheduling and Control (3 units)

Description: Develop an enhanced understanding of construction project planning, scheduling, execution, and control in preparation to contribute to construction firms, project management consultants, and owners upon graduation. Topics include network scheduling, critical path method, resource allocation, cost control, software applications to scheduling, and contract documents.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 582

Course typically offered:

Main Campus: Fall, Spring

Field trip: Evaluate construction sites for impacts on constructability.

Enrollment requirement: Adv Stdg: Engineering.

CE 483: Construction Cost Estimating (3 units)

Description: Develop an enhanced understanding of quantity take-off and cost estimating of construction resources including materials, labor, and equipment. Skills and knowledge of cost estimating will provide preparation for builders and designers to contribute to construction firms, project management consultants, and owners upon graduation. Topics include: types of cost estimates; budget estimates; preconstruction services estimates; quantity take-off; self-performed work estimates; subcontractor work estimates; and bid preparation.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with:

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Advanced Standing in Engineering; MATH 129 or MATH 250B; CE 381 or equivalent experience; or with consent of instructor.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 485: Construction Equipment and Methods (3 units)

Description: Develop an enhanced understanding of construction equipment and methods to contribute to construction firms, project management consultants, and owners upon graduation. Topics include: costing, safety, earth moving equipment, cranes, creating and securing deep digs, constructing deep foundations, and forms and temporary structures.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CE 585

Course typically offered:

Main Campus: Fall, Spring

Field trip: Site visits require appropriate attire, including a hard hat and safety vest which can be checked out the day of the site visit from the CEEM office at the Civil Engineering Building, Room 206. Also required are boots and pants (preferably jeans).

Enrollment requirement: Adv Stdg: Engineering. MATH 129 or MATH 250B; CE 381 or equivalent experience; or with consent of instructor.

CE 493: Internship (1 - 5 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

Student Engagement Activity: Professional Development

Student Engagement Competency: Professionalism

CE 494: Practicum (1 - 3 units)

Description: The practical application, on an individual basis, of previously studied theory and the collection of data for future theoretical interpretation.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

Student Engagement Activity: Professional Development

Student Engagement Competency: Professionalism

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 499: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

CE 499H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering. Honors active.

Honors Course: Honors Course

Honors Course: Honors Course

CE 502: Introduction to Finite Element Methods (3 units)

Description: Theory and formulation procedures: energy and residual. One-dimensional problems: stress analysis in axial structures, steady and transient fluid and heat flow, consolidation, wave-propagation, beam-column. Two-dimensional problems: field and plane/axisymmetric, use of computer codes for solution to typical problems. Graduate-level requirements include research on a single aspect of the finite element method.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: EM 502

Also offered as: EM 502

Co-convened with: CE 402

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Dynamics of immiscible fluids in porous and fractured media; anisotropy and scale; advective solute transport; consolidation and land subsidence; multiaquifer systems; free surface flow and salt water/fresh water interfaces.

Career: Graduate

Equivalent to: CE 503

Also offered as: HWRS 503

Course typically offered:

Main Campus: Fall (even years only)

Recommendations and additional information: MATH 250B or MATH 254 or MATH 355; CE 218.

Home department: Hydrology and Atmospheric Sciences

Description: This course is for senior undergraduate and graduate students. The goal of this course is to introduce commonly used numerical methods for ordinary and partial differential equations encountered in transport problems in environmental systems. The course covers finite difference and finite element methods with emphasis on basic discretization schemes and how to select the appropriate numerical schemes for a given differential equation. We will also discuss accuracy, stability, and convergence properties of the introduced numerical methods. Students will use MATLAB or other programming languages to implement numerical schemes to solve example problems. Experience with MATLAB is not required.

Career: Graduate

Equivalent to: CE 504, HYDR 504

Also offered as: HWRS 504

Course typically offered:

Main Campus: Spring (odd years only)

Home department: Hydrology and Atmospheric Sciences

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 510: Probability in Civil Engineering (3 units)

Description: [Usually offered every third semester beginning Fall 2001] Outlines the extent of uncertainties under which civil engineering designs and decisions are made. Theory and application. Advanced topics in risk-based engineering design. System reliability concepts. Statistical decision theory and its application in civil engineering. Identifying and modeling, nondeterministic problems in engineering in understanding many recently issued engineering codes. Graduate-level requirements include a project paper.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convened with: CE 410

Course typically offered:

Main Campus: Fall, Spring

CE 522: Open-Channel Flow (3 units)

Description: [Usually offered every three semesters beginning Fall 2007] Differential equations governing unsteady flow in open channels. Simple surface waves in subcritical and supercritical flows. Introduction of kinematic, diffusion, and dynamic wave methods. Applications to reservoir routing, dam break flow, and overland flow. Graduate-level requirements includes a project paper.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ABE 522

Also offered as: BE 522

Co-convened with: CE 422

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 323 or consent of instructor.

CE 523: Hydrology (3 units)

Description: Discussion and analysis of major topics of the hydrologic cycle and their interrelationship, such as rainfall, infiltration, evaporation, and runoff. Statistical and probabilistic methods in water supply and flood hydrology. Graduate-level requirements include a project paper.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ARL 523, ARL 523, HWRS 523, HYDR 523

Also offered as: ARL 523, ATMO 523, HWRS 523

Co-convened with: CE 423

Course typically offered:

Main Campus: Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 524: Sedimentation Engineering (3 units)

Description: Sediment transport is an engineering science that addresses the movement and transportation of solid granular particles in open channel flows. It deals with the hydrodynamics of sediment-laden flow and the mechanism of sediment motion in the particle-liquid two-phase flow. The first part of this course aims to provide an introduction of fundamental principles governing flow and sediment transport and apply these principles to solve practical problems such as designing stable channel, estimating flow resistance, quantifying sediment load. The second part is river mechanics that examines river dynamics and bank stability and introduces basic engineering measures to cost-effective maintain river stability and prevent flooding.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with:

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Consent of Instructor.

Field trip: Nine

CE 525: Sediment Transport Analysis (3 units)

Description: This web-based distance-deliverable course is to teach engineering practitioners and college students the basic principles of sediment transport and gain the skills of performing sediment transport analysis using hydraulic models, such as the HEC-RAS4.1. The course consists of three parts: fundamental theories of hydraulic models, basis of sediment transport models, and application of HEC-RAS unsteady flow and sediment transport models. Practice examples are designed based on two dry land rivers in Arizona: the Rillito River and the Pantano Wash. 60% of the content is the fundamental principles that govern flow and sediment transport in open channel flows, and 40% is regarding the application of HEC-RAS models. Concepts of bed material, bed load, and suspended load, formulas to predict bed load, suspended load, and total load, methods to estimate fluvial resistances based on bed forms (e. g. ripples, dunes, antidunes), calculation of local scour and bank erosion, and design of stable channels are also included.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: CE 218 and CE 323.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 526: Watershed Engineering (3 units)

Description: Design of waterways, erosion control structures and small dams. Methods for frequency analysis and synthetic time distribution of rainfall. Methods for estimating infiltration and runoff from small watersheds, flow routing and storm water management. Estimating erosion using the Revised Universal Soil Loss Equation. Graduate-level requirements include a special project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 526, WSM 526

Also offered as: BE 526, WSM 526

Co-convened with: CE 426

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Home department: Biosystems Engineering

CE 527: Computer Applications in Hydraulics (3 units)

Description: Computer modeling of surface water hydrology, flood plain hydraulics and water distribution systems. Theoretical basis. Application and design studies. Graduate-level requirements include a research paper or project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ABE 527, HWRS 527

Also offered as: BE 527, HWRS 527

Co-convened with: CE 427

Course typically offered:

Main Campus: Spring

CE 529: Special Topics in Hydraulics & Water Resources Engineering (3 units)

Description: Selected advanced topics will be covered in the fields of hydraulics and water resources engineering with emphasis on analysis and design of water systems. Graduate-level requirements include a research paper and/or a comprehensive design project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Repeatable: Course can be repeated for a maximum of 9 units.

Co-convened with: CE 429

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 532: Advanced Structural Design in Steel (3 units)

Description: Advanced problems in the analysis and design of steel structures including beam columns, plate girders, composite construction, multi-story buildings; static and dynamic lateral and vertical loads; connections; computer applications. Graduate-level requirements include a comprehensive design project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 432

Course typically offered:

Main Campus: Fall, Spring

CE 534: Design of Wood and Masonry Structures (3 units)

Description: [Usually offered every third semester beginning Spring 2002] Determination of gravity and lateral loads on structures. Design of wood structures for axial load and bending; structural wood panels, diaphragms and shear walls. Types of masonry construction. Graduate-level requirements include a comprehensive design project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 434

Course typically offered:

Main Campus: Fall, Spring

CE 535: Prestressed Concrete Structures (3 units)

Description: Behavior, analysis and design of statically determinate and indeterminate prestressed concrete structures; calculation of loss of prestress. Usually offered every other Spring beginning 2003. Graduate-level requirements may include a research paper or a comprehensive design project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 435

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 333, CE 335.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: [Usually offered every other Spring beginning 2002] Advanced problems in the analysis and design of concrete structures, design of slender columns and one- and two-way slabs; lateral and vertical load analysis of bridges and multistory buildings; introduction to design for torsion and seismic forces; use of structural computer programs. Graduate-level requirements may include a research paper or a comprehensive design project.

Career: Graduate

Co-convened with: CE 437

Course typically offered:

Main Campus: Fall, Spring

Description: Structural systems, gravity load resisting systems, lateral force resisting systems, tall building design, computer structural analysis, structural steel, reinforced concrete, building codes, seismic resistant design. Graduate level requirements include project leadership roles, advanced analysis components in projects.

Career: Graduate

Co-convened with: CE 438

Course typically offered:

Main Campus: Spring

Description: Settlement and bearing capacity of shallow and deep foundations; beam on elastic foundation; design of footings and pile foundations; foundations on metastable soils; the use of computer codes for foundation problems. Graduate-level requirements include the development of computer codes for the solution of specified foundation problems or an in-depth research paper on a specific aspect of foundation engineering.

Career: Graduate

Co-convened with: CE 440

Course typically offered:

Main Campus: Fall

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 541: Earth Structures in Geotechnical Engineering (3 units)

Description: Stability analysis for earth slopes, including planar, circular piecewise-linear, and composite-surface methods; analyses for static and steady-flow conditions; earth pressure theories and calculations for generalized conditions; design of rigid and flexible retaining structures; design of braced and tie-back shoring systems; design of reinforced earth walls; computer-aided analysis and design. Graduate-level requirements include a research paper and/or a comprehensive design project.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convened with: CE 441

Course typically offered:

Main Campus: Fall, Spring

CE 542: Ground Improvement (3 units)

Description: This course will talk about different ground improvement techniques including those without addition of materials, by adding materials and using reinforcing elements. During the course, opportunities will be given to students to develop a range of generic skills including written communication skills, problem solving skills and analysis and critical evaluation skills. Upon successful completion of this course, the student will be able to - Understand the principles, applications, and design procedures for various ground improvement techniques. Use analytical/theoretical/numerical calculations to assess the effectiveness of a ground improvement technique. Gain competence in properly evaluating alternative solutions, and the effectiveness before, during and after using ground improvement. Graduate-level requirements include a term paper for 20% of grade.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 442

Course typically offered:

Main Campus: Fall, Spring

CE 543: Block Theory Applications for Rock Mass Stability (3 units)

Description: The objective of the short course is to show the applications of block theory for rock mass surficial and underground excavations. Three papers will be given to illustrate the application of theory to shiplock slopes of the Three Gorges dam site, China, a mine in Arizona and a highway rock slope in Arizona.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 544: Special Topics In Geomechanics (3 units)

Description: Introduction to geoenvironmental engineering; physiochemical and microstructural behavior of geomaterials, effect of pollutants, design of waste disposal systems; advanced laboratory testing, geotextiles, space geomechanics, etc. Usually offered every third semester starting Spring 2003. Graduate-level requirements include a research paper and/or a comprehensive design project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 444

Course typically offered:

Main Campus: Fall, Spring

CE 545: Geoenvironmental Engineering (3 units)

Description: Waste generation and disposal regulations; types and characterization of wastes, engineering properties of soil-water-contaminants; use of earth and geosynthetic materials in waste containment applications; evaluation, design and construction of liner and leachate collection systems used in landfills and heap leach mining; remediation of contaminated sites. Usually offered every third semester beginning Fall 2002. Graduate-level requirements include separate exams and term projects that involve the evaluation and design of a landfill expansion and a landfill cover system for closure.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convened with: CE 445

Course typically offered:

Main Campus: Fall, Spring

CE 546: Geotechnical Earthquake Engineering (3 units)

Description: Review of plate tectonics and seismology, analysis of earthquake ground motions, travel path and distance effects, and site response effects. Soil liquefaction susceptibility, identification, and mitigation. Introduction to seismic slope stability. Graduate level requirements include a research paper and/or a comprehensive design project.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Equivalent to: GEN 546

Also offered as: GEN 546

Co-convened with: CE 446

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-**CC** represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 548: Numerical Methods in Geotechnical Engineering (3 units)

Description: Brief statements and applications of numerical methods based on closed-form solutions, finite difference and finite element methods for problems involving soil structure interaction such as piles, retaining walls, group piles, underground works; seepage; and consolidation. Graduate-level requirements include additional assignments, e.g. a research paper on specific topics.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 448

Course typically offered:

Main Campus: Fall, Spring

CE 549: Statistical Hydrology (3 units)

Description: Application of statistics and probability to uncertainty in the description, measurement, and analysis of hydrologic variables and processes, including extreme events, error models, simulation, sampling. Graduate-level requirements include an in-depth simulation project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 549

Also offered as: HWRS 549

Course typically offered:

Main Campus: Fall

Home department: Hydrology and Atmospheric Sciences

CE 555: Soil and Water Resources Engineering (3 units)

Description: Introduction to soil and water relationships, irrigation systems, irrigation water supply, and irrigation management; basic designs. Graduate-level requirements include a special project on a current irrigation topic.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 555

Also offered as: BE 555

Co-convened with: CE 455

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Home department: Biosystems Engineering

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 556: Irrigation Systems Design (3 units)

Description: Design and operation of surface, sprinkler, and trickle irrigation systems based on economic and environmental criteria. Graduate-level requirements include a special project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 556

Also offered as: BE 556

Co-convened with: CE 456

Course typically offered:

Main Campus: Spring (odd years only)

Distance Campus: Spring (odd years only)

Home department: Biosystems Engineering

CE 558: Soils, Wetlands and Wastewater Reuse (3 units)

Description: Water quality and system design for agricultural drainage and waste-water systems. Graduate-level requirements include a special project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 558

Also offered as: BE 558

Co-convened with: CE 458

Course typically offered:

Main Campus: Spring (even years only)

Distance Campus: Spring (even years only)

Home department: Biosystems Engineering

CE 560: Special Topics in Transportation Engineering (3 units)

Description: Selected advanced topics will be covered in the field of transportation engineering, with emphasis on analysis and design of transportation systems. Graduate-level requirements include a research paper or project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Repeatable: Course can be repeated for a maximum of 9 units.

Equivalent to: WRA 560

Co-convened with: CE 460

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 561: Traffic Modeling & Simulation (3 units)

Description: The course will cover various modeling and simulation approaches used in studying traffic dynamics and control in a transportation network. The model-based simulation tools discussed include dynamic macroscopic and microscopic traffic flow simulation and assignment models. Models will be analyzed for their performance in handling traffic dynamics, route choice behavior, and network representation.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 561

Also offered as: SIE 561

Course typically offered:

Main Campus: Fall

Online Campus: Fall

Distance Campus: Fall

Home department: Systems & industrial Engineering

-SA represents a Student Abroad & Student Exchange offering

-**CC** represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 562: Traffic Engineering and Operations (3 units)

Description: Two-thirds of urban vehicle-miles of travel in the U.S. are on signal-controlled roadways. Traffic control systems are designed and installed to achieve two primary goals -- safety and efficiency -- by providing orderly movement in all directions. However, present traffic control systems are by no means a perfect solution for delay or crash problems on urban roads. A poorly designed traffic control system can have a negative impact on traffic operations by lengthening vehicle delay, increasing the rate of vehicle crashes, and introducing disruptions to traffic progression. On a national average, poor signal timing causes up to fifteen percent excess vehicle delay, sixteen percent excess vehicle stops, seven percent excess travel time, and nine percent excess fuel consumption. A previous study reported that there are roughly 300,000 traffic signals in the U.S. and about 75 percent of them could be improved easily and inexpensively. This indicates that huge benefits are potentially obtainable through traffic control system optimizations. In recent years, traffic detectors have been intensively deployed in major highway systems across the country. These sensors generate tremendous traffic data that are extremely valuable for traffic management, forecast, and control. How to manage the data efficiently and produce the most useful information out of them have been crucial challenges faced by traffic professionals. Therefore, this course introduces important concepts and principles of traffic system design, geometric characteristics, and operation of streets and highways, including planning aspects, traffic design and control, and highway safety. Simulation modeling and application of these concepts and principles to actual situations will be emphasized to evaluate traffic system performance. Graduate level requirements will include a research paper related to this course. The research topic has to be decided before Midterm exam 1. The deadline of the term project is the final exam day. The paper format should follow the TRB paper author guide.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convener with: CE 462

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Departments allowed to enroll will be CE, SE, IE, EM, CEEM, and Planning majors or permission from the instructor.

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-**CC** represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 562A: Public Transit Planning and Operations (3 units)

Description: [Taught odd-numbered years] Development, operation, management, financing, evaluation and travel demand estimation for urban public transportation systems. Graduate-level requirements include a project, as an additional requirement over and above the undergrads.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: PLG 562A

Also offered as: PLG 562A

Co-convened with: CE 462A

Course typically offered:

Main Campus: Fall, Spring

CE 563: Traffic Flow and Capacity Analysis (3 units)

Description: Methods for the efficient and safe operation of transport facilities through analysis of capacity, safety, speed, parking, and volume data. Usually offered every third semester beginning Fall 2001. Graduate-level requirements include a research paper or project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 463

Course typically offered:

Main Campus: Fall, Spring

CE 564A: Integrated Highway Bridge Design Using LRFD Methodology (3 units)

Description: Methods for the integrated design of components typically found in transportation structures including bridge super- and sub-structures, retaining walls, pavements, highway geometrics, traffic, drainage, etc. Taught by practicing engineers. Graduate-level requirements include a 35-question comprehensive final exam (25% of final numerical score).

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 464A

Course typically offered:

Main Campus: Spring

Recommendations and additional information: CE 310, CE 323, CE 335, CE 343, and CE 363.

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 565: Transportation Data Management and Analysis (3 units)

Description: This course introduces important concepts of database design and application. Popular database and analytical tools are introduced and demonstrated using traffic sensor data, roadway geometric data, and traffic accident data. The objective is to introduce modern concepts, algorithms, and tools for transportation data management and analysis. With the instructions, assignments, and projects in this course, students are expected to learn database design theories; analytical methods for capacity, safety, and time series analyses; and skills on popular software tools for transportation data management and analysis. Graduate students should expect additional problems (additional 10%) in each midterm exam to cover additional materials given to the graduate students. More details will be provided during midterm exam review sessions.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 465

Course typically offered:

Main Campus: Fall, Spring

CE 566: Highway Geometric Design (3 units)

Description: Study of geometric elements of streets and highways, with emphasis on analysis and design for safety. Offered every third semester. Graduate-level requirements include a research paper or project.

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$25

Course Components: Lecture Required

Co-convened with: CE 466

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 363.

CE 567: Traffic Safety (3 units)

Description: The following course is intended to introduce topics in traffic safety. Included will be information on how to understand and utilize crash data, safety analysis methods described in the Highway Safety Manual, statistical methods in safety analysis, human factors and crash causality, and an overview of other emerging safety issues and resources.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 467

Course typically offered:

Main Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 568: Urban Transportation Planning (3 units)

Description: Transportation planning in relation to urban development; techniques and procedures for developing long-range regional plans. Usually offered every third semester beginning Fall 2002. Graduate-level requirements include a research paper or project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 568, PLAN 568, PLN 568, PLNG 568

Also offered as: PLG 568, RED 568

Co-convened with:

Course typically offered:

Main Campus: Fall

Home department: Planning

CE 569: Travel Demand Modeling (3 units)

Description: Detailed investigation of methods to model travel demand, covering data collection and analysis, model development, and forecasting applications. Graduate-level requirements include a research paper or project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 469

Course typically offered:

Main Campus: Fall, Spring

CE 573: Biodegradation of Hazardous Organic Compounds (3 units)

Description: To learn and integrate the basic principles of microbiology required for understanding of application of bioremediation to contaminated sites. To become familiar with current research in bioremediation. To learn to solve problems often encountered in application of bioremediation.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 573

Also offered as: CHEE 573

Co-convened with: CE 473

Course typically offered:

Main Campus: Spring

Home department: Chemical & Environmental Engineering

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 574: Fate and Transport Processes in Environmental Engineering (3 units)

Description: Processes affecting mass transfer and transformation in natural and engineered environmental systems. Process modeling using reactor models. Mass transfer kinetics and equilibrium. Mass and energy balances.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 574, CHE 574

Also offered as: CHEE 574

Course typically offered:

Main Campus: Spring

Home department: Chemical & Environmental Engineering

CE 576A: Water Treatment System Design (3 units)

Description: Application of theory and engineering experience to the design of unit operations for the production of potable water. Covers water regulations, conventional treatment technologies and selected advanced treatment topics. Graduate-level requirements include a research paper.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 576A

Also offered as: CHEE 576A

Co-convened with: CE 476A

Course typically offered:

Main Campus: Fall

Home department: Chemical & Environmental Engineering

CE 576B: Wastewater Treatment Design System (3 units)

Description: Application of theory and engineering experience to the design of unit operations for the treatment of wastewater. Covers water regulations, conventional treatment technologies and selected advanced treatment topics. Graduate-level requirements include additional homework problems, a course paper, and additional exam questions.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 576B

Also offered as: CHEE 576B

Co-convened with: CE 476B

Course typically offered:

Main Campus: Fall

Home department: Chemical & Environmental Engineering

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Management, planning, legal and engineering aspects of liquid and solid hazardous waste treatment and disposal. Graduate-level requirements include additional homework problems, a term paper, and additional exam questions.

Career: Graduate

Equivalent to: CE 578

Also offered as: CHEE 578

Co-convened with: CE 478

Course typically offered:

Main Campus: Spring

Home department: Chemical & Environmental Engineering

Description: Develop an enhanced understanding of construction project planning, scheduling, execution, and control in preparation to contribute to construction firms, project management consultants, and owners upon graduation. Topics include network scheduling, critical path method, resource allocation, cost control, software applications to scheduling, and contract documents. Graduate students will be expected to complete additional or alternate problems throughout the semester and present content and problem solutions in class.

Career: Graduate

Co-convened with: CE 482

Course typically offered:

Main Campus: Fall, Spring

Field trip: Site visits require appropriate attire, including a hard hat and safety vest which can be checked out the day of the site visit from the CEEM office at the Civil Engineering Building, Room 206. Also required are boots and pants (preferably jeans).

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 583: Construction Cost Estimating (3 units)

Description: Develop an enhanced understanding of quantity take-off and cost estimating of construction resources including materials, labor, and equipment. Skills and knowledge of cost estimating will provide preparation for builders and designers to contribute to construction firms, project management consultants, and owners upon graduation. Topics include: types of cost estimates; budget estimates; preconstruction services estimates; quantity take-off; self-performed work estimates; subcontractor work estimates; and bid preparation. Graduate students will be expected to complete additional or alternate problems throughout the semester and present content and problem solutions in class.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with:

Course typically offered:

Main Campus: Fall, Spring

Field trip: Site visits require appropriate attire, including a hard hat and safety vest which can be checked out the day of the site visit from the CEEM office at the Civil Engineering Building, Room 206. Also required are boots and pants (preferably jeans).

CE 584A: Soil Engineering (3 units)

Description: The objective of this course is to prepare you to identify, characterize, and evaluate prevalent soil types in Arizona and to design safe and economical foundations.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

CE 585: Construction Equipment and Methods (3 units)

Description: Develop an enhanced understanding of construction equipment and methods to contribute to construction firms, project management consultants, and owners upon graduation. Topics include: costing, safety, earth moving equipment, cranes, creating and securing deep digs, constructing deep foundations, and forms and temporary structures. Graduate students will be expected to complete additional or alternate problems throughout the semester and present content and problem solutions in class.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CE 485

Course typically offered:

Main Campus: Fall, Spring

Field trip: Site visits require appropriate attire, including a hard hat and safety vest which can be checked out the day of the site visit from the CEEM office at the Civil Engineering Building, Room 206. Also required are boots and pants (preferably jeans).

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 593: Internship (1 - 5 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 594: Practicum (1 - 3 units)

Description: The practical application, on an individual basis, of previously studied theory and the collection of data for future theoretical interpretation.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 596A: Research Topics (1 unit)

Description: For CE and EM majors, research presentation only.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Seminar Required

Repeatable: Course can be repeated a maximum of 2 times.

Equivalent to: EM 596A

Also offered as: EM 596A

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: May be repeated one time for credit when enrolled in the Ph.D. program.

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 599: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work. Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 606: Wave Propagation in Solids (3 units)

Description: [Usually offered every other Spring beginning 2003] Stress (acoustic wave propagation and dispersion in infinite solids and finite wave guides), application of wave propagation theory in destructive and nondestructive evaluation of materials and structures; dynamic failure behavior of materials.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: AME 606, AME 660, CE 660, EM 606, EM 660

Also offered as: AME 606, EM 606

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: AME 564A or AME 564B.

CE 630: Advanced Catchment Hydrology (3 units)

Description: Concepts and methodology required to upscale near-surface hydrologic processes to catchment scales with development of watershed models to quantify hydrologic response in different climates. Special attention given to how landscape geomorphologic structure affects hydrologic behavior.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 630

Also offered as: HWRS 630

Course typically offered:

Main Campus: Fall (even years only)

Recommendations and additional information: HWRS 518, HWRS 519, or consent of instructor. Computer programming skills (e.g. MATLAB, C++).

Home department: Hydrology and Atmospheric Sciences

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 632: Infrastructure Rehabilitation (3 units)

Description: [Usually offered every other Spring beginning 2003] Status of infrastructure and causes of deterioration of constructed facilities. Strengthening of bridges and buildings. Application of advanced modern materials such as fiber composites in new structures and for rehabilitation of existing structures.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 333, CE 334.

CE 633: Reinforced Concrete (3 units)

Description: [Usually offered every other Fall beginning 2002] Inelastic behavior of beams and columns; short- and long-term beam deflections; combined bending, shear, and torsion in beams; behavior under load reversals; analysis and design of beam to column connections and shear walls.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: C E 437 or consult department before enrolling.

CE 638: Advanced Structural Stability (3 units)

Description: [Usually offered every other Spring beginning 2002] The course covers stability theory as it pertains to structural engineering. The lectures will primarily involve theoretical derivations of stability behavior and how this theory is translated into design rules. Course coverage begins at the structural member level, including the examination of in-plane elastic stability, in-plane inelastic stability, and three-dimensional elastic stability. The course concludes with an examination of two-dimensional structural stability, including elastic-plastic collapse of frames.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 655: Stochastic Methods in Surface Hydrology (3 units)

Description: Topics and applications will vary with instructor. Advanced application of statistics and probability to hydrology, time series analysis and synthesis, and artificial neural network methods, as applied in the modeling of hydro-climatic sequences or Bayesian and other analyses in the decision making process of water resources. A combination of theory and application to the fields of hydrology, environmental and water resources engineering, climatic modeling, and other related natural resource modeling.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Equivalent to: CE 655

Also offered as: HWRS 655

Course typically offered:

Main Campus: Fall (even years only)

Recommendations and additional information: Consult with course instructor.

Home department: Hydrology and Atmospheric Sciences

CE 663: Advanced Transportation Modeling and Analysis (3 units)

Description: [Taught even-numbered years] Introduction of advanced modeling and solution techniques for management and operation problems in the modern urban transportation systems. A term project is required in addition to regular scheduled homework assignments and exams.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Repeatable: Course can be repeated a maximum of 3 times.

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 310, CE 363. Concurrent registration; Student should selection one of the following courses: MATH 215, SIE 540, SIE 544, SIE 545, or SIE 546.

CE 676: Advanced Water and Wastewater Treatment (3 units)

Description: Advanced design for water and wastewater treatment. Emphasis on modern environmental engineering processes for water and wastewater treatment.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 676

Also offered as: CHEE 676

Course typically offered:

Main Campus: Fall

Home department: Chemical & Environmental Engineering

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CE 900: Research (1 - 9 units)

Description: Individual research, not related to thesis or dissertation preparation, by graduate students.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 909: Master's Report (1 - 12 units)

Description: Individual study or special project or formal report thereof submitted in lieu of thesis for certain master's degrees.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 910: Thesis (1 - 12 units)

Description: Research for the master's thesis (whether library research, laboratory or field observation or research, artistic creation, or thesis writing). Maximum total credit permitted varies with the major department.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CE 920: Dissertation (1 - 12 units)

Description: Research for the doctoral dissertation (whether library research, laboratory or field observation or research, artistic creation, or dissertation writing).

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.