Civil and Environmental Engineering

The Department of Civil and Environmental Engineering (CEE) offers a Master of Science (MS) program, a doctoral degree (PhD) program, and a Master of Engineering (MEng) program.

CEE also offers three concurrent degree programs and two certificate programs.

Master of Science (MS) and Doctor of Philosophy (PhD)

These academic degrees emphasize the application of the natural sciences to the analysis and solution of engineering problems. Advanced courses in mathematics, chemistry, physics, and the life sciences are normally included in a program that incorporates the engineering systems approach for analysis of problems.

Students in these degree programs select one of the following 7 concentrations:

1. **Energy, Civil Infrastructure and Climate:** The objective of the Energy, Civil Infrastructure and Climate (ECIC) program is to educate a cadre of professionals who will be able to analyze from engineering, environmental, economic, and management perspectives complex problems such as energy efficiency of buildings, environmentally-informed design of transportation systems, embodied energy of construction materials, and electricity from renewable sources, as well as biofuels. The analysis will be used to address such overarching societal problems as mitigation of greenhouse gas emissions and adaptation of infrastructure to a changing climate. ECIC also promotes research at the intersection of energy, infrastructure and climate science.
2. **Engineering and Project Management:** The Engineering and Project Management (E&PM) program educates students for leadership positions in managing infrastructure, especially construction projects, and within field, project, and corporate management. Contemporary project management practice demands that the engineering professionals not only have a mastery of engineering, including construction concepts, but also a strong background in engineering and management methods. E&PM emphasizes new technologies, developments, and techniques in both domestic and international project management and construction, as well as the interrelationships of all life-cycle components: planning, design, manufacturing, construction, operation, maintenance, and end-of-life options.
3. **Environmental Engineering:** The Environmental Engineering program encompasses air quality engineering (AQE), water quality engineering (WQE), and environmental fluid mechanics and hydrology (EFMH). AQE focuses on indoor microenvironments, plume dispersion, urban and regional air pollution, as well as global changes in climate and atmospheric chemistry. There is an emphasis on environmental and public health issues related to the built environment, including energy and transportation systems. EFMH focuses on physical processes that govern air and water movement, and the associated transport of contaminants, energy, and other scalars. It takes an integrated approach to studies of the coastal ocean and estuaries, the atmospheric boundary layer, surface and subsurface water flow, land-atmosphere interactions, the management of water resource systems, climate change and variability, and contaminant transport. WQE addresses the sources, transport and treatment of chemical and microbiological contaminants that affect water. Research and coursework focus on assessment of the sources, fate and transport of contaminants and the development of natural and engineered treatment systems for chemical contaminants and human pathogens.
4. **GeoSystems (Geoengineering)**: GeoSystems encompasses a broad area of teaching and research in geotechnical and geological engineering, environmental geotechnics, and applied geophysics. GeoSystems' focus is on the evaluation of engineering properties of geologic materials and on providing engineering solutions for dealing with geologic environment and processes, and natural hazards. Emphasis is on the study of the mechanical behavior of soil and rock masses, laboratory and field characterization of material properties, development and application of geophysical techniques for site and subsurface characterization, development of advanced analysis methods, and evaluation of static and dynamic (seismic) performance of soil deposits, earth structures, and underground space.
5. **Structural Engineering, Mechanics, and Materials:** The Structural Engineering, Mechanics, and Materials (SEMM) program consists of three emphases: structural engineering, which is concerned with the analysis and design of all types of structures, including earthquake-resistant design; structural mechanics, which employs the disciplines of applied mathematics and the engineering sciences to examine problems in the behavior of structural elements and systems, and to investigate the mathematical description of properties; and structural materials engineering, which is concerned with the development of construction materials (e.g., steel, concrete, aluminum alloys, timber, plastic, and composite materials) for engineering projects, such as mechanical and thermal response, microstructure behavior, and durability.
6. **Systems (Civil Systems):** The focus of the Systems Program is to understand complex large-scale systems and to develop tools for their design and operation. Such systems encompass built elements (infrastructures transportation, structures), societal systems (social networks, populations enterprises), and natural systems (land, water, air). The understanding of how such systems work requires knowledge about the constitutive laws that govern them, such as traffic flow, fluid mechanics, structural mechanics, and smart networks. It also requires an understanding of the theoretical paradigms (e.g., theories of computation and control, optimization, behavioral economics, sensor networks, statistics, and signal processing) that are used to model, control and optimize such systems.
7. **Transportation Engineering:** The Transportation Engineering (TE) program is concerned with the planning, design, construction, operation, performance, evaluation, maintenance, and rehabilitation of transportation systems and facilities, such as highways, railroads, urban transit, air transportation, logistic supply systems and their terminals. There is an emphasis on the economic and public policy aspects involved in transportation systems as well. TE stresses development of analytic, problem-solving, design, and management skills suitable for public and private sector professional work.

Students in the PhD program have the option of pursuing a Designated Emphasis (DE) to supplement their study. A designated emphasis is a specialization, such as a new method of inquiry or an important field of application, and it is relevant to 2 or more existing doctoral degree

programs. Some of the DE's open to students in CEE's PhD program are Computational Science and Engineering (http://guide.berkeley.edu/archive/2014-15/graduate/degree-programs/computational-science-engineering) , and Nanoscale Science and Engineering (http://guide.berkeley.edu/archive/2014-15/graduate/degree-programs/nanoscale-science-engineering) .

Master of Engineering (MEng)

This professional degree emphasizes solving technical, sociological, environmental, and economic problems involved in the design, construction, and operation of engineering structures, processes, and equipment. Studies include courses in the engineering sciences necessary to the engineering interpretation of the latest scientific developments. Courses in design, operation, humanities, and economics provide bases for the analysis and solution of problems in professional engineering.

Students in this degree program select either a concentration in Systems (Civil Systems) or Transportation Engineering (see above descriptions). There are options for either full-time or part-time enrollment.

CEE's MEng program is offered in conjunction with the Fung Institute for Engineering Leadership (http://funginstitute.berkeley.edu) .

Concurrent Degrees

The concurrent degree program is a formal arrangement of two existing, but separate, master's degree programs, which result in the students earning two master's degrees. CEE offers the following concurrent degree programs:

1. Structural Engineering (http://ced.berkeley.edu/academics/architecture/programs/concurrent-programs/structural-engineering) and Architecture (http://ced.berkeley.edu/admissions/graduate) (MArch/MS)
2. Transportation Engineering (http://ced.berkeley.edu/academics/city-regional-planning/programs/concurrent-programs/transportation-engineering) and City and Regional Planning (http://ced.berkeley.edu/academics/city-regional-planning) (MCP/MS)
3. Any CEE graduate program and Public Policy (http://socrates.berkeley.edu/%7Egspp) (MPP/MS)

For further information regarding these programs, please see the department's website (http://www.ce.berkeley.edu/grad/degrees) .

Certificates

Certificate in Engineering and Business for Sustainability: This program is open to all Berkeley graduate students who meet the EBS Certificate course requirements. The EBS Certificate program allows students to tap into multidisciplinary educational resources from the College of Engineering (http://coe.berkeley.edu) , Haas School of Business (http://haas.berkeley.edu) , Energy and Resources Group (http://erg.berkeley.edu) , Goldman School of Public Policy (http://gspp.berkeley.edu) , College of Natural Resources (http://nature.berkeley.edu/site) , and the School of Public Health (http://sph.berkeley.edu) , to learn how to have a lasting beneficial impact on the global environment. For further information regarding this program, please see the department's website (http://sustainable-engineering.berkeley.edu) .

Certificate in Intelligent Transportation Systems: Jointly sponsored by CEE, the Department of Electrical Engineering & Computer Science and Mechanical Engineering, this program is designed to assist students to study ITS in a systematic and focused way. Faculty advisors help students design a personalized study program to meet their goals. For more information regarding this program, please see the department's website (http://www.ce.berkeley.edu/grad/degrees/requirements/trans/detailed/certificate) .

Admission to the University

Uniform minimum requirements for admission

The following minimum requirements apply to all programs and will be verified by the Graduate Division:

1. A bachelor's degree or recognized equivalent from an accredited institution;
2. A minimum grade-point average of B or better (3.0);
3. If the applicant comes from a country or political entity (e.g. Quebec) where English is not the official language, adequate proficiency in English to do graduate work, as evidenced by a TOEFL score of at least 570 on the paper-and-pencil test, 230 on the computer-based test, 90 on the iBT test, or an IELTS Band score of at least 7 (note that individual programs may set higher levels for any of these); and
4. Enough undergraduate training to do graduate work in the given field.

Applicants who already hold a graduate degree

The Graduate Council views academic degrees as evidence of broad research training, not as vocational training certificates; therefore, applicants who already have academic graduate degrees should be able to take up new subject matter on a serious level without undertaking a graduate program, unless the fields are completely dissimilar.

Programs may consider students for an additional academic master's or professional master's degree if the additional degree is in a distinctly different field.

Applicants admitted to a doctoral program that requires a master's degree to be earned at Berkeley as a prerequisite (even though the applicant already has a master's degree from another institution in the same or a closely allied field of study) will be permitted to undertake the second master's degree, despite the overlap in field.

The Graduate Division will admit students for a second doctoral degree only if they meet the following guidelines:

1. Applicants with doctoral degrees may be admitted for an additional doctoral degree only if that degree program is in a general area of knowledge distinctly different from the field in which they earned their original degree. For example, a physics PhD could be admitted to a doctoral degree program in music or history; however, a student with a doctoral degree in mathematics would not be permitted to add a PhD in statistics.
2. Applicants who hold the PhD degree may be admitted to a professional doctorate or professional master's degree program if there is no duplication of training involved.

Applicants may only apply to one single degree program or one concurrent degree program per admission cycle.

Any applicant who was previously registered at Berkeley as a graduate student, no matter how briefly, must apply for readmission, not admission, even if the new application is to a different program.

Required documents for admissions applications

1. **Transcripts:** Upload unofficial transcripts with the application for the departmental initial review. Official transcripts of all college-level work will be required **if admitted**. Official transcripts must be in sealed envelopes as issued by the school(s) you have attended. Request a current transcript from every post-secondary school that you have attended, including community colleges, summer sessions, and extension programs.
   If you have attended Berkeley, upload unofficial transcript with the application for the departmental initial review. Official transcript with evidence of degree conferral ***will not*** be required if admitted.
2. **Letters of recommendation:** Applicants can request online letters of recommendation through the online application system. Hard copies of recommendation letters must be sent directly to the program, not the Graduate Division.
3. **Evidence of English language proficiency:** All applicants from countries in which the official language is not English are required to submit official evidence of English language proficiency. This requirement applies to applicants from Bangladesh, Burma, Nepal, India, Pakistan, Latin America, the Middle East, the People's Republic of China, Taiwan, Japan, Korea, Southeast Asia, and most European countries. However, applicants who, at the time of application, have already completed at least one year of full-time academic course work with grades of B or better at a U.S. university may submit an official transcript from the U.S. university to fulfill this requirement. The following courses will not fulfill this requirement: 1) courses in English as a Second Language, 2) courses conducted in a language other than English, 3) courses that will be completed after the application is submitted, and 4) courses of a non-academic nature. If applicants have previously been denied admission to Berkeley on the basis of their English language proficiency, they must submit new test scores that meet the current minimum from one of the standardized tests.

Admission to the Program

CEE's minimum graduate admission requirements

- A bachelor's degree from an accredited institution or recognized equivalent.
- Sufficient undergraduate education for graduate work in your chosen field.
- A satisfactory scholastic average, with a *minimum* grade-point average (GPA) of 3.0 (B) for application consideration.
- Score of the general Graduate Record Examination (GRE (http://www.gre.org)) taken during the past five years. CEE does not require a GRE subject test but the General GRE Test is required. Both the "Old" GRE and the "Revised" GRE are accepted.
- International applicants: A *minimum* score of 90/120 iBT (230 CBT, 570 PBT) on the Test of English as a Foreign Language (TOEFL (http://www.toefl.org)), taken during the past two years, is required to meet the English Language Proficiency requirement.
- A Master's of Science degree from an accredited university if you are applying directly for the PhD.
- In addition, each of the 7 CEE programs has its own admissions requirements (see below). Applicants need to follow the requirements and prerequisites of their chosen program.

Energy, Civil Infrastructure, and Climate

Prerequisites

- Bachelor's degree from an accredited institution or recognized equivalent
- 1.5 years of college-level calculus
- 1 semester probability and statistics
- 1 semester elementary linear algebra
- 1 year college-level physical science (e.g.PHYSICS 7A Physics for Scientists and Engineers)
- A course in thermodynamics or energy conversion (can be taken as part of graduate study). Example courses in thermodynamics and energy conversion at Berkeley include:

ENGIN 115	Engineering Thermodynamics	4
MEC ENG 40	Thermodynamics	3
MEC ENG 254	Thermodynamics I	3
CHM ENG 141	Chemical Engineering Thermodynamics	4
MEC ENG 146	Energy Conversion Principles	3

Engineering and Project Management

Prerequisites

- 1 year college-level calculus
- 1 year college-level physical science (e.g. PHYSICS 7A and PHYSICS 7B Physics for Scientists and Engineers)
- 1 semester probability and statistics
- 1 semester elementary linear algebra

Environmental Engineering

Prerequisites

Minimum requirements for entry into the Environmental Engineering program consist of:

- Math: equivalent of 2 years, including calculus, linear algebra and differential equations
- Science: 1 semester of physics, 2 additional semesters of science (physics, chemistry, biology)

Additionally, it is strongly recommend that applicants have:

- Experience with Matlab or other high-level programming language
- Physics and/or chemistry coursework beyond the minimum listed above

The Environmental Engineering program also considers the following courses to be additional prerequisites of the program. These courses can be taken during a student's graduate study, but if they are, the courses would not count towards the graduate degree:

CIV ENG 100	Elementary Fluid Mechanics	4
CIV ENG 111	Environmental Engineering	3

One of these courses may be taken as part of the graduate program:

CIV ENG 103	Introduction to Hydrology
or CIV ENG 11!	Water Chemistry

Note: applications from non-engineering students are strengthened if engineering classes, particularly those considered prerequisite to the program, have already been taken at the time of application.

GeoSystems (Geoengineering)

Prerequisites

Select one of the following or equivalent:

MATH 1A/1B	Calculus	
MATH 53 & MATH 54	Multivariable Calculus and Linear Algebra and Differential Equations	
CHEM 1A	General Chemistry (or equivalent)	3
PHYSICS 7A	Physics for Scientists and Engineers	4
CIV ENG C30	Introduction to Solid Mechanics	3
CIV ENG 70	Engineering Geology	3
CIV ENG 175	Geotechnical and Geoenvironmental Engineering	3

Structural Engineering, Mechanics and Materials

Prerequisites

1 year college-level calculus:		
MATH 1A/1B	Calculus	
MATH 53 & MATH 54	Multivariable Calculus and Linear Algebra and Differential Equations	
Equivalent		
1 year college-level physical science:		
PHYSICS 7A/7B	Physics for Scientists and Engineers	
Equivalent		
1 semester probability and statistics:		
STAT 20	Introduction to Probability and Statistics	
CIV ENG 93	Engineering Data Analysis	
Equivalent		
1 semester elementary linear algebra		
1 semester course in matrix structural analysis		
CIV ENG 121	Advanced Structural Analysis	
Equivalent		

Systems (Civil Systems)

Prerequisites

- 1.5 years college-level calculus
- 1 year college-level physical science (e.g., PHYSICS 7A/PHYSICS 7B Physics for Scientists and Engineers)
- 1 semester probability and statistics
- 1 semester elementary linear algebra
- A GPA for the junior/senior years of at least 3.25

Transportation Engineering

Prerequisites

- 1 year college-level calculus
- 1 year college-level physical science (e.g., PHYSICS 7A/PHYSICS 7B Physics for Scientists and Engineers)
- 1 semester probability and statistics (See *Statistics/linear algebra diagnostic* below.)
- 1 semester elementary linear algebra

Transportation Engineering requires strong analytical and quantitative preparation, but an engineering degree is not necessary. Applicants must be fluent with quantitative concepts equivalent to 1 year of college level calculus, 1 year of college level physical science, including a physics course on mechanics and waves (such as PHYSICS 7A/PHYSICS 7B Physics for Scientists and Engineers) and 1 semester of engineering level probability and statistics.

Deficiencies in preparation must be remedied by additional work that may not count toward the degree. Students should discuss their preparation with their faculty advisor.

Statistics/linear algebra diagnostic

Incoming students, including transfers into the Transportation Engineering program from within Berkeley, must take a diagnostic test at the beginning of their first semester in the program to see if their linear algebra, and probability and statistics preparation is adequate, i.e., on a level similar to CIV ENG 93 Engineering Data Analysis.

Consisting of 4 or 5 problems, the diagnostic test does not emphasize memorization. Rather, it tests whether students are capable of applying linear algebra and statistical concepts to solve simple transportation problems. If students do not solve most of the problems easily, or do not take the test, they must enroll in CIV ENG 262 Analysis of Transportation Data during their first semester. This requirement cannot be put off to a later time.

Lack of linear algebra knowledge may be remedied by working through a suitable book, such as the Schaum's Outline Series.

See Example Statistics Diagnostic for First Year TE Grad Students (http://www.ce.berkeley.edu/system/files/assets/programs/trans/diagnostic.pdf)

Curriculum

The doctoral program is research-based and is not solely based on the curricula below. All doctoral students are expected to fulfill a major and two minors which total at least 30 units or its equivalent. Each PhD student must have a graduate advisor to provide general academic guidance, and a research advisor to supervise the student's dissertation and to assist in identifying funding paths. A minimum 3.5 GPA is required in major course work and a 3.0 in minor course work. Usually during the first year or second year a prequalifying examination is required as well as a qualifying examination during the 3rd year. For detailed information, please see the department website (http://www.ce.berkeley.edu/home?destination=home) .

Energy, Civil Infrastructure and Climate concentration

CIV ENG 107	Climate Change Mitigation	3
CIV ENG 268E	Civil Systems and the Environment	3
CIV ENG 292A	Technologies for Sustainable Societies	1
CIV ENG 295	Energy Systems and Control	3
CIV ENG 299	Individual Research	1-12
At least 15 units of CIV ENG electives, from each of the following core areas (maximum 6 units in any one area):		
Environment Science & Engineering		
Civil Infrastructure		
Economics & Policy		
9 units in each in two minor fields (may be within CEE)		

Engineering and Project Management concentration

CIV ENG 299	Individual Research	1-12

A major field of 18 units related to the thesis and 2 minor fields, with 1 minor consisting of courses outside CEE. The minor typically consists of 2 or 3 graduate or advanced undergraduate level courses.

Environmental Engineering concentration

For the major field: minimum 12 units from courses numbered CIV ENG 200-CIV ENG 219:

CIV ENG 200A	Environmental Fluid Mechanics
CIV ENG 200B	Numerical Methods for Environmental Flow Modeling
CIV ENG 200C	Transport and Mixing in the Environment
CIV ENG 202A	Vadose Zone Hydrology
CIV ENG 203N	Surface Water Hydrology
CIV ENG 205B	Margins of Quality for Engineered Systems
CIV ENG 209	Design for Sustainable Communities
CIV ENG 210A	Control of Water-Related Pathogens
CIV ENG 211A	Environmental Physical-Chemical Processes
CIV ENG 211B	Environmental Biological Processes
CIV ENG 213	Watersheds and Water Quality
CIV ENG 217	Environmental Chemical Kinetics
CIV ENG 218A	Air Quality Engineering
CIV ENG 218B	Atmospheric Aerosols
CIV ENG 218C	Air Pollution Modeling

Two minors with two courses each, minimum 12 units total.

Additional requirements: [1]

[1] One minor must be outside of CEE; graduate-level or undergraduate-level courses may be used for the outside minor.

GeoSystems concentration

Faculty advisor approved study list per student's research interests. The major field consists of 18 units of Civ Eng courses focusing around a GeoSystems area of research. The two minor fields of 8 units each, one of which consists of courses outside CEE, support the dissertation topic. Minimum 30 units overall.

Structural Engineering, Mechanics & Materials (SEMM) concentration

21 units of SEMM courses for the major field. At least 15 units at the graduate level.

Courses for two minor fields:

One minor should address the student's technical base and research background and include two graduate level courses. For a computer science minor, one of the following areas should be taken: [1]

Databases:

COMPSCI 162	Operating Systems and System Programming
COMPSCI 186	Introduction to Database Systems
COMPSCI 286A	Introduction to Database Systems
COMPSCI 286I	Implementation of Data Base Systems
COMPSCI 287	Advanced Robotics

Computer Graphics:

COMPSCI 184	Foundations of Computer Graphics
COMPSCI 284A	Foundations of Computer Graphics
COMPSCI 284B	Advanced Computer Graphics Algorithms and Techniques
COMPSCI 285	Course Not Available

Software Engineering:

COMPSCI 164	Programming Languages and Compilers
COMPSCI 269	Course Not Available

Artificial Intelligence:

COMPSCI 188	Introduction to Artificial Intelligence
COMPSCI 283I	Course Not Available
COMPSCI 269	Course Not Available
COMPSCI 287	Advanced Robotics
COMPSCI 288	Natural Language Processing
COMPSCI 289	Course Not Available

One minor must be Mathematics or Statistics in one of the following areas: Traditional Mathematics:

Traditional Mathematics:

MATH 104	Introduction to Analysis
& MATH 185	and Introduction to Complex Analysis (OR)
or	
MATH 121A	Mathematical Tools for the Physical Sciences
& MATH 121B	and Mathematical Tools for the Physical
& MATH 222A	Sciences
& MATH 222B	and Partial Differential Equations
& MATH 224A	and Partial Differential Equations
& MATH 224B	and Mathematical Methods for the Physical Sciences
	and Mathematical Methods for the Physical Sciences

Modern Mathematics:

MATH 104	Introduction to Analysis
MATH 202A	Introduction to Topology and Analysis
MATH 202B	Introduction to Topology and Analysis

Numerical Analysis:

MATH 110	Linear Algebra
MATH 128A	Numerical Analysis
MATH 128B	Numerical Analysis
MATH 221	Advanced Matrix Computations
MATH 228A	Numerical Solution of Differential Equations
MATH 228B	Numerical Solution of Differential Equations

Statistics:

MATH 110	Linear Algebra
STAT 200A	Introduction to Probability and Statistics at an Advanced Level
STAT 200B	Introduction to Probability and Statistics at an Advanced Level

For Materials emphasis:

Two units of CE 299 (individual study or research) during your first semester of residence. Approved course work should satisfy a major within SEMM and two minor areas appropriate for your area of research. One minor should be in SEMM and the other minor should be outside of CEE. The minors are subject to the approval of the Vice Chair for Academic Affairs. A minor in math is not required.

Systems Engineering concentration

At least 15 units (excluding research) in major, 3 of which may be upper-division courses.

Four out of seven Systems graduate courses:	
CIV ENG 229	Structural System Reliability
CIV ENG 264	Behavioral Modeling for Engineering, Planning, and Policy Analysis
CIV ENG 271	Sensors and Signal Interpretation
CIV ENG 290	Advanced Special Topics in Civil and Environmental Engineering (sect 1. Spatiotemporal Data Analytics)
CIV ENG 290	Advanced Special Topics in Civil and Environmental Engineering (sect 2. Energy Systems and Control)
CIV ENG 290I	Civil Systems: Control and Information Management
CIV ENG C291F	Control and Optimization of Distributed Parameters Systems
Two minor fields where only one can be in CEE. Each minor is a group of three upper-division and/or graduate courses. One semester of teaching is also required. CE 301 must be taken concurrently with the first teaching rotation.	

Transportation Engineering concentration

CIV ENG courses in Transportation Engineering should include the following:

CIV ENG C250	Transportation Policy and Planning
CIV ENG 251	Operation of Transportation Facilities
CIV ENG 252	Systems Analysis in Transportation
CIV ENG 262	Analysis of Transportation Data
The remaining course work should support a special emphasis in an area of interest and in 2 minors.	

CIV ENG 301 is required for all students who are teaching for the first time on Berkeley campus.

Curriculum

Energy, Civil Infrastructure & Climate Overview concentration

Courses Required

CIV ENG 107	Climate Change Mitigation	3
CIV ENG 268E	Civil Systems and the Environment	3
CIV ENG 292A	Technologies for Sustainable Societies	1
CIV ENG 295	Energy Systems and Control	3
CIV ENG 299	Individual Research	3
Thesis option: 6 units from the three core areas, Environmental Science and Engineering, Civil Infrastructure, and Economics and Policy, but no more than 3 units in any one area. A thesis signed by three committee members is also required. [1]		6
Comprehensive Exam option: 9 units from the three core areas, Environmental Science and Engineering, Civil Infrastructure, and Economics and Policy, but no more than 6 units in any one area. A comprehensive examination is also required. [1]		9

[1] See department website (http://www.ce.berkeley.edu/programs/ecic/courses) for more details.

Engineering & Project Management concentration

Courses Required

CIV ENG 268A	Lean Construction Concepts and Methods	3
CIV ENG 268B	Lean Construction and Supply Chain Management	3
CIV ENG 268D	Law for Engineers	3
CIV ENG 268E	Civil Systems and the Environment	3
CIV ENG 268H	Advanced Project Planning and Control	3
CIV ENG 268I	Business Fundamentals for Engineers	3
CIV ENG 298	Group Studies, Seminars, or Group Research	1-6
Thesis option: At least 8 units from the list above. Remaining courses, minimum 12 units, comes from courses approved by the faculty advisor. No more than 4 units of CE 299 may count. A thesis with a 3-person committee is required with two CEE members, one from EPM.		
Comprehensive Exam option: 12 units from the above list are required. 12 units from a course list approved by the faculty advisor. No more than 4 units of CE 299 may count. A comprehensive examination is required in the Spring.		

Environmental Engineering concentration

Courses Required

CIV ENG 200A	Environmental Fluid Mechanics
CIV ENG 202A	Vadose Zone Hydrology
CIV ENG 211A	Environmental Physical-Chemical Processes
CIV ENG 211B	Environmental Biological Processes
CIV ENG 218A	Air Quality Engineering
Thesis option: individualized study list approved by adviser and a thesis approved by a committee of three, including two environmental faculty and preferably one member outside CEE.	
Comprehensive Exam option: individualized study list plus 3 courses from following (but only one of CE 211A or CE 211B) as well as a comprehensive exam in fall or spring	

GeoSystems concentration

Courses Required

Thesis option: 9 units of graduate level courses and the remaining 11 units from a list approved by the faculty advisor. 3 units may be CE 299 research units. Minimum 12 units per semester.		
Comprehensive Project: 12 units of graduate level courses, and the remaining 12 from a list approved by the faculty advisor. A written report from at least 3 units of CE 299 or a capstone project from CE 273 is required.		
CIV ENG 270	Advanced Geomechanics	3
CIV ENG 271	Sensors and Signal Interpretation	3
CIV ENG 272	Numerical Modelling in Geomechanics	3
CIV ENG 273	Advanced GeoEngineering Testing and Design	3
CIV ENG 275	Geotechnical Earthquake Engineering	3
CIV ENG C276	Seismic Hazard Analysis and Design Ground Motions	3
CIV ENG 277	Advanced Foundation Engineering	3
CIV ENG 281	Engineering Geology	3
CIV ENG 285C	Seismic Methods in Applied Geophysics	3

CIV ENG 286	Digital Data Processing	3
CIV ENG 290J	Advanced Topics in Geotechnical Engineering	3

Structural Engineering, Mechanics & Materials concentration

Courses Required

Thesis option: At least 8 units from the list above. Remaining courses, minimum 12 units, comes from courses approved by the faculty advisor. No more than 4 units of CE 299 may count. A thesis with a 3-person committee is required with two CEE members, one from EPM. [1]

Comprehensive Project/Exam option: 14 units of graduate level SEMM courses are required. 10 units from a course list approved by the faculty advisor. No more than 4 units of CE 299 may count. A comprehensive examination, or report approved by two faculty, is required in the Spring. [1]

CIV ENG 220	Structural Analysis Theory and Applications	3
CIV ENG 221	Nonlinear Structural Analysis	3
CIV ENG 222	Finite Element Methods	3
CIV ENG 223	Earthquake Protective Systems	3
CIV ENG 225	Dynamics of Structures	3
CIV ENG 226	Stochastic Structural Dynamics	3
CIV ENG 227	Earthquake-Resistant Design	3
CIV ENG 228	Advanced Earthquake Analysis	3
CIV ENG 229	Structural System Reliability	3
CIV ENG C231	Mechanics of Solids	3
CIV ENG 232	Structural Mechanics	3
CIV ENG 233	Computational Mechanics	3
CIV ENG 234	Computational Inelasticity	3
CIV ENG C235	Statistical Mechanics of Elasticity	3
CIV ENG C236	Micromechanics	3
CIV ENG C237	Computational Nano-mechanics	3
CIV ENG 240	Civil Engineering Materials	3
CIV ENG 241	Concrete Technology	3
CIV ENG 244	Reinforced Concrete Structures	3
CIV ENG 245	Behavior of Reinforced Concrete	3
CIV ENG 246	Prestressed Concrete Structures	3
CIV ENG 247	Design of Steel and Composite Structures	3
CIV ENG 248	Behavior and Plastic Design of Steel Structures	3
CIV ENG 249	Experimental Methods in Structural Engineering	3

1 See department website (http://www.ce.berkeley.edu/programs/semm/courses) for more details.

Systems Engineering concentration

Courses Required

4 core courses to be taken from a pool of 7 core classes:		
CIV ENG 229	Structural System Reliability	
CIV ENG 263N	Scalable Spatial Analytics	3
CIV ENG 264	Behavioral Modeling for Engineering, Planning, and Policy Analysis	3
CIV ENG 268E	Civil Systems and the Environment	3
CIV ENG 271	Sensors and Signal Interpretation	
CIV ENG 290I	Civil Systems: Control and Information Management	
CIV ENG C291F	Control and Optimization of Distributed Parameters Systems	
CIV ENG 295	Energy Systems and Control	3
4 elective courses making up a coherent subject specialization chosen with approval of the systems graduate advisor		
Capstone paper or completion of a capstone course		

Transportation Engineering concentration

Courses Required

The Fundamentals are required of all MS students. No course may count in more than one area. Transportation Engineering students are required to take a course from Policy, Modal, and Analysis, while Transportation Systems students are required to take Modal, Analysis and Systems.

Fundamentals (all):		
CIV ENG 251	Operation of Transportation Facilities	
CIV ENG 252	Systems Analysis in Transportation	
CIV ENG 262	Analysis of Transportation Data	
Policy area:		
CIV ENG C250	Transportation Policy and Planning	
CIV ENG 256	Transportation Sustainability	
Modal area:		
CIV ENG 153	Transportation Facility Design	
CIV ENG 253	Intelligent Transportation Systems	
CIV ENG 255	Highway Traffic Operations	
CIV ENG 259	Public Transportation Systems	
CIV ENG 260	Air Transportation	
Analysis area:		
CIV ENG 254	Transportation Economics	
CIV ENG 258	Logistics	
CIV ENG 261	Infrastructure Systems Management	
CIV ENG 263	Operations of Transportation Terminals	
CIV ENG 264	Behavioral Modeling for Engineering, Planning, and Policy Analysis	
CIV ENG 290I	Civil Systems: Control and Information Management	
CIV ENG 290F	Advanced Topics in Seismology	
Systems area:		
CIV ENG 271	Sensors and Signal Interpretation	
CIV ENG 290I	Civil Systems: Control and Information Management	
CIV ENG C291F	Control and Optimization of Distributed Parameters Systems	

Curriculum

Transportation Engineering concentration (Intelligent Transportation Systems Track)

Courses Required

Core Technical courses:		
CIV ENG 251	Operation of Transportation Facilities	
CIV ENG 252	Systems Analysis in Transportation	
And 2 courses (6 units) from the following:		6
CIV ENG 253	Intelligent Transportation Systems	

CIV ENG 255	Highway Traffic Operations
CIV ENG 259	Public Transportation Systems
CIV ENG 260	Air Transportation
CIV ENG 264	Behavioral Modeling for Engineering, Planning, and Policy Analysis
Core Leadership courses:	
ENGIN 271	Engineering Leadership I
ENGIN 272	Engineering Leadership II
ENGIN 296MA	Master of Engineering Capstone Project
ENGIN 296MB	Master of Engineering Capstone Project
A capstone project is required at the end of the program. A part-time option is available as well. [1]	

1 See the Fung Institute website (http://funginstitute.berkeley.edu/masters) for more information.

Systems concentration

Courses Required

Core Technical Courses (12 units) choose 4 courses:	
CIV ENG 264	Behavioral Modeling for Engineering, Planning, and Policy Analysis
CIV ENG 271	Sensors and Signal Interpretation
CIV ENG C289/ EL ENG 249	Embedded System Design: Modeling, Analysis, and Synthesis
CIV ENG 290I	Civil Systems: Control and Information Management
CIV ENG C291E	Control and Optimization of Distributed Parameters Systems
Core Leadership courses:	
ENGIN 271	Engineering Leadership I
ENGIN 272	Engineering Leadership II
ENGIN 296MA	Master of Engineering Capstone Project
ENGIN 296MB	Master of Engineering Capstone Project
A capstone project is required at the end of the program. A part-time option is available as well. [1]	

1 See Fung Institute website (http://funginstitute.berkeley.edu/masters) for more information.

Civil and Environmental Engineering

CIV ENG 200A Environmental Fluid Mechanics 3 Units
Fluid mechanics of the natural water and air environment. Flux equation analyses; unsteady free surface flow; stratified flow; Navier-Stokes equations; boundary layers, jets and plumes; turbulence, Reynolds equations, turbulence modeling; mixing, diffusion, dispersion, and contaminant transport; geophysical flows in atmosphere and ocean; steady and unsteady flow in porous media. Application to environmentally sensitive flows in surface and groundwater and in lower atmosphere.
Rules & Requirements

Prerequisites: 100; Mathematics 53, 54 or equivalents

Credit Restrictions: Students will receive no credit for 200A after taking 105 before fall 1999.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Chow, Stacey

Formerly known as: 105

CIV ENG 200B Numerical Methods for Environmental Flow Modeling 3 Units
Introduction to numerical methods with application to environmental flows (atmospheric, surface water, and subsurface flows). Scalar advection/diffusion equations used to study finite difference schemes, numerical errors and stability. Methods introduced for solving Navier-Stokes equations and for turbulence modeling with Reynolds-averaging and large-eddy simulation. Basic programming skills required for hands-on exercises.
Rules & Requirements

Prerequisites: 200A or consent of instructor

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Chow

Formerly known as: 204

CIV ENG 200C Transport and Mixing in the Environment 3 Units
Application of fluid mechanics to transport and mixing in the environment. Fundamentals of turbulence, turbulent diffusion, and shear dispersion in steady and oscillatory flows and the effects of stratification. Application to rivers, wetlands, lakes, estuaries, the coastal ocean, and the lower atmosphere.
Rules & Requirements

Prerequisites: 100, MATH 53 and 54, or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Stacey

Formerly known as: 209A

CIV ENG 202A Vadose Zone Hydrology 3 Units
Course addresses fundamental and practical issues in flow and transport phenomena in the vadose zone, which is the geologic media between the land surface and the regional water table. A theoretical framework for modeling these phenomena will be presented, followed by applications in the areas of ecology, drainage and irrigation, and contaminant transport. Hands-on applications using numerical modeling and analysis of real-life problems and field experiments will be emphasized.
Rules & Requirements

Prerequisites: 173 or equivalent

Credit Restrictions: Students will receive no credit for 202A after taking 202 before fall 1998.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Rubin

Formerly known as: 202

CIV ENG 203A Graduate Hydrology 3 Units
Hydrology is presented and analyzed in the context of a continuum extending from the atmosphere to the land surface to the subsurface to free water bodies. In this class, we develop the theoretical frameworks required to address problems that both lie within individual components and span these traditionally separate environments. Starting from a development of the fundamental dynamics of fluid motion, we examine applications within the subsurface, the atmosphere and surface water systems.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Thompson, Rubin

CIV ENG 203N Surface Water Hydrology 3 Units
Course addresses topics of surface water hydrology, such as processes of water in the atmosphere, over land surface, and within soil; advanced representation and models for infiltration and evapotranspiration processes; partition of water and energy budgets at the land surface; snow and snowmelt processes; applications of remote sensing; flood and drought, and issues related to advanced hydrological modeling. Students will address practical problems and will learn how to use the current operational hydrologic forecasting model, and build hydrological models.
Rules & Requirements

Prerequisites: 103 or equivalent, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Formerly known as: 203

CIV ENG 205B Margins of Quality for Engineered Systems 3 Units
Processes and procedures to define and determine the demands and capacities of the structures and hardware elements of engineered systems during their life-cycles: margins of quality. The objective of this course is to provide students with the knowledge and skills to define and evaluate system demands, capacities, and reliabiltity targets to be used in design, requalification, construction, operation, maintenance, and decommissioning of engineered systems.
Rules & Requirements

Prerequisites: 125, 193 or equivalents and senior design experience

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Bea

CIV ENG 209 Design for Sustainable Communities 3 Units
This course provides conceptual and hands-on experience in design and implementation of innovative products or processes for improving the sustainability of resource-constrained communities (mostly poor ones in the developing countries). Teams of students will take on practical projects, with guidance from subject experts.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Gadgill

CIV ENG 210A Control of Water-Related Pathogens 3 Units
Comprehensive strategies for the assessment and control of water-related human pathogens (disease-causing microorganisms). Transmission routes and life cycles of common and emerging organisms, conventional and new detection methods (based on molecular techniques), human and animal sources, fate and transport in the environment, treatment and disinfection, appropriate technology, regulatory approaches, water reuse.
Rules & Requirements

Prerequisites: Basic course in microbiology recommended; graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Nelson

CIV ENG 211A Environmental Physical-Chemical Processes 3 Units
Fundamental concepts of physical-chemical processes that affect water quality in natural and engineered environmental systems. Focus is on developing a qualitative understanding of mechanisms as well as quantitative tools to describe, predict, and control the behavior of physical-chemical processes. Topics include reactor hydraulics and reaction kinetics, gas transfer, adsorption, particle characteristics, flocculation, gravitational separations, filtration, membranes, and disinfection.
Rules & Requirements

Prerequisites: 111 or equivalent and course work in aquatic chemistry, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Nelson

CIV ENG 211B Environmental Biological Processes 3 Units
Fundamental concepts of biological processes that are important in natural and engineered environmental systems, especially those affecting water quality. Incorporates basic fundamentals of microbiology into a quantifiable engineering context to describe, predict, and control behavior of environmental biological systems. Topics include the stoichiometry, energetics and kinetics of microbial reactions, suspended and biofilm processes, carbon and nutrient cycling, and bioremediation applications.
Rules & Requirements

Prerequisites: 111 or equivalent and course work in microbiology, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Alvarez-Cohen

CIV ENG 213 Watersheds and Water Quality 3 Units
Overview of approaches used by engineers to preserve or improve water quality at the watershed scale. Characterization and modeling of nutrients, metals, and organic contaminants in watersheds. Application of ecosystem modification and pollutant trading to enhance water quality. The course emphasizes recent case studies and interdisciplinary approaches for solving water quality problems.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Credit Restrictions: Students will receive no credit for 213 after taking 290C.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Sedlak

CIV ENG 217 Environmental Chemical Kinetics 3 Units
Kinetic aspects of chemical fate and transport in aquatic systems. Quantitative descriptions of the kinetics of intermedia transport and pollutant transformation by abiotic, photochemical, and biological reactions. Techniques for the estimation of environmental reaction rates. Development of models of pollutant behavior in complex natural systems.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor; 115 or 214 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Sedlak

CIV ENG 218A Air Quality Engineering 3 Units
Quantitative overview of the characterization and control of air pollution problems. Summary of fundamental chemical and physical processes governing pollutant behavior. Analysis of key elements of the air pollution system: sources and control techniques, atmospheric transformation, atmospheric transport, modeling, and air quality management.
Rules & Requirements

Prerequisites: Graduate standing in engineering or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Nazaroff, Harley

CIV ENG 218B Atmospheric Aerosols 3 Units
Nature, behavior and signifance of airborne particulate matter. Size distributions. Transport phenomena and deposition processes. Light scattering, visibility impairment, and climate consequences. Aerosol thermodynamics and kinetics of phase-change processes, including nucleation. Phase partitioning of semivolatile species. Coagulation. Atmospheric sources including primary and secondary particle formation. Loss mechanisms including wet and dry deposition. Technological controls.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor, Civil and Environmental Engineering 218A recommended

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Nazaroff

CIV ENG 218C Air Pollution Modeling 3 Units
Theory and practice of mathematical air quality modeling. Modeling atmospheric chemical transformation processes. Effects of uncertainty in model parameters on predictions. Review of atmospheric diffusion theory and boundary layer meteorology. Dispersion modeling. Combining chemistry and transport.
Rules & Requirements

Prerequisites: 218A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Harley

CIV ENG 220 Structural Analysis Theory and Applications 3 Units
Theory and applications of modern structural analysis. Direct stiffness method. Matrix formulations. Virtual work principles. Numerical solution methods. Modeling and practical analysis of large frame structures. Elastoplastic analysis of frames. P-delta effects.
Rules & Requirements

Prerequisites: 121 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Filippou

CIV ENG 221 Nonlinear Structural Analysis 3 Units
Theory, modeling, and computation for analysis of structures with material and geometric nonlinearities. Sources of nonlinearity. Solution strategies for static and dynamic loads. Modeling of inelastic materials and members. P-delta and large deformation theory. Analysis of stability. Practical applications.
Rules & Requirements

Prerequisites: 220

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Filippou

CIV ENG 222 Finite Element Methods 3 Units
Approximation theory for analysis of deformation and stress in solids. Finite element formulations for frame, plane stress/strain, axisymmetric, torsion, and three-dimensional elastic problems. The isoparametric formulation and implementation. Plate and shell elements. Finite element modeling of structural systems.
Rules & Requirements

Prerequisites: 220 or equivalent, 131 or 231

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Filippou, Govindjee

CIV ENG 223 Earthquake Protective Systems 3 Units
Conceptual basis for earthquake protective systems including seismic isolation and energy absorbing techniques. Design rules for seismic isolation, energy absorbing and self-centering systems. Characteristics of isolation bearings, frictional, metallic and energy absorbing devices, code provision for earthquake protective systems. Applications to new and existing structures.
Rules & Requirements

Prerequisites: 220, 225, or consent of instructor

Credit Restrictions: Students will receive no credit for 223 after taking 290D.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Mahin, Panagiotou

Formerly known as: 290D

CIV ENG W224A Introduction to Earthquake Engineering 3 Units
Introduction to key concepts in earthquake engineering, including engineering seismology, dynamics of single-degree-of-freedom systems, earthquake ground motions, seismic hazard assessment, performance-based earthquake engineering, geotechnical design for earthquakes, and structural design for earthquakes.
Objectives & Outcomes

Course Objectives: The goal of this course is to provide students with introductory knowledge of earthquake engineering to serve as the basis for more advanced and specialized courses to follow. This knowledge aims towards general exposure to elements of earthquake hazard, ground motion, structural dynamics, and design and evaluation of structural systems. An important objective of this introductory course is to emphasize the importance of risk analysis and performance-based earthquake engineering

Rules & Requirements

Prerequisites: Civil and Environmental Engineering 120, 175, 122N, 123N or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Mosalam, Bray

CIV ENG W224B Linear Analysis of Structural and Geotechnical Systems 3 Units
Methods of linear static and dynamic analysis of structural and geotechnical systems; displacement method of analysis and direct stiffness implementation; modeling of structural and geotechnical systems; 1d and 2d finite elements; equations of motions; modal analysis and direct integration; linear response evaluation methods.
Objectives & Outcomes

Course Objectives: The goal of this course is to provide students with background knowledge of the linear elastic response of structural and geotechnical systems. The modules introduce the students to the modeling of structures and foundations, the concepts of the displacement method of analysis for skeletal structures and to basic concepts of finite element analysis. The modules also cover the modal analysis of multi-degree of freedom elastic systems. The assigned homework enables students to analyze and evaluate the linear elastic static and dynamic response of structural systems.

Rules & Requirements

Prerequisites: Civil and Environmental Engineering C30/Mechanical Engineering C85; Civil and Environmental Engineering 120, 121 and 175 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Filippou, Chopra, Pestana

CIV ENG W224C Earthquake Geotechnical Engineering 3 Units
Earthquake surface fault rupture, earthquake ground motions; influence of soil conditions on seismic site response; seismic site response analysis; evaluation and modeling of dynamic soil properties; seismic performance of foundations and soil structure interaction; evaluation and mitigation of soil liquefaction and its consequences; seismic slope stability and displacement analysis; seismic safety of dams, levees, embankments; seismic design of earth retaining structures.
Objectives & Outcomes

Course Objectives: The goal of this course is to familiarize students with the field of earthquake geotechnical engineering. Lectures focus on describing earthquake hazards and developing methods used for seismic analysis and design in geotechnical engineering. Assigned problems and projects reinforce essential concepts and provide realistic applications of prevalent analytical procedures. Readings provide necessary background information and are an essential component of the course.

Rules & Requirements

Prerequisites: Civil and Environmental Engineering W224A or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Bray, Seed

CIV ENG W224D Nonlinear Analysis of Structural and Geotechnical Systems 3 Units
Response of structural systems with nonlinear materials under large displacements; event-to-event analysis for simple material response; nonlinear solution strategies; linear stability analysis; second order analysis; section analysis for nonlinear material response (moment-curvature, interaction diagrams); truss and beam-column elements with nonlinear materials; nonlinear time history analysis of structures; case studies of nonlinear response.
Objectives & Outcomes

Course Objectives: The goal of this course is to provide students with background knowledge of the nonlinear response of structural systems. The modules cover the nonlinear response of materials and structural components as well as the nonlinear response of structures under large displacements. The modules also cover the numerical methods for the static and transient response of structures. The assigned homework enables students to analyze and evaluate the response of structural systems under extreme load and environmental conditions inducing large inelastic strains of structural materials and large displacements of structural systems.

Rules & Requirements

Prerequisites: Civil and Environmental Engineering W224B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Filippou, McKenna

CIV ENG W224E Earthquake Resistant Design 2 Units
Design of structures to resist earthquakes excitations. Characterization of earthquakes for design. Development of design criteria for elastic and inelastic structural response. Seismic performance of various structural systems. Prediction of nonlinear seismic behavior. Basis for code design procedures. Preliminary design of steel and reinforced concrete structures. Evaluation of earthquake vulnerability of existing structures and rehabilitation of seismic deficiencies.

Objectives & Outcomes

Course Objectives: The goal of this course is to provide students with skills in the evaluation and design of earthquake-resistant structures. The course brings together knowledge of engineering seismology, geotechnical engineering, and structural engineering learned in previous courses and develops concepts and analytical methods for earthquake engineering. An overall objective is for students to understand the characteristics of earthquake-resistant construction and to recognize the basic structural framing systems that are commonly in use.

Rules & Requirements

Prerequisites: Civil and Environmental Engineering W224A, W224C, W224D or equivalents

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Mahin, Panagiotou

CIV ENG W224F Risk Analysis and Decision Making 2 Units
Risk analysis and seismic policy issues for pre-event planning and post-event recovery: Topics will include national and local policies governing seismic safety, risk modeling, resilience metrics and lessons from policy and planning before and after recent major events in Japan, New Zealand, Italy, China, Haiti, Chile, and others.

Objectives & Outcomes

Course Objectives: The goal of this course is to expose students to risk and decision-making aspects that influence planning for earthquakes and post-earthquake recovery. The modules consist of a series of real-world case studies that reveal policies that govern seismic safety, models for risk assessment, and community resilience. A unique objective of this course is to expose students to aspects of earthquake engineering that are outside the usual realm of engineering and reside instead in areas of public policy, economics, and decision-making.

Rules & Requirements

Prerequisites: Civil and Environmental Engineering W224A

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Comerio, Moehle

CIV ENG W224G Earthquake Resistant Concrete Structures 2 Units
Design methods for earthquake-resistant concrete construction; materials including confined concrete; design of beams, columns, and walls; structural diaphragms; foundations; conventional construction and hybrid construction; applications for buildings and bridges.

Objectives & Outcomes

Course Objectives: The goal of this course is to provide students with a working knowledge of how reinforced concrete structures respond to earthquakes and how to design such structures to be earthquake-resistant. The modules introduce students to common forms of concrete construction and analytical methods for establishing requirements for such structures. The assigned homework enables students to develop experience in analyzing and designing earthquake-resistant concrete structures

Rules & Requirements

Prerequisites: Civil and Environmental Engineering 123N or equivalent; Civil and Environmental Engineering W224A, W224D, W224E may be taken concurrently

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Moehle, Panagiotou

CIV ENG W224H Earthquake-Resistant Steel Structures 2 Units
Design methods for earthquake-resistant steel structures; material properties of steel, welds, and bolts; design of tension members, beams, columns, and beam-columns; connections including shear and moment connections, gusset plates, and base plates; floor diaphragms; lateral force resisting systems; concentrically braced frames; moment frames; eccentrically braced frames; steel shear walls; applications to buildings and bridges

Objectives & Outcomes

Course Objectives: The goal of this course is to provide students with a working knowledge of how steel structures respond to earthquakes and how to design such structures to be earthquake-resistant. The modules introduce students to common steel structural framing systems to resist gravity and lateral forces and concepts and methods for seismic design of such structures. The assigned homework enables students to develop experience in analyzing and designing earthquake-resistant steel structures.

Rules & Requirements

Prerequisites: CE W224A, CE W224D, CE W224E

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Astaneh

CIV ENG W224I Dynamic Response of Foundations/Soil-Structure Interaction 2 Units
Dynamic response of foundations, design of foundations to resist seismic loading, influence of liquefaction on deep foundations, soil-structure interaction.
Objectives & Outcomes

Course Objectives: The objective of the course is to provide in depth coverage of seismic soil-structure interaction as it pertains to seismic design of major foundation elements: footings, piles and piers; and seismic design of various types of retaining structures. To this end case histories will be used to illustrate past experience and then current analysis and design methods will be covered in detail. Assignments will be structured to provide students with the necessary tools for application of the methods in design of new structures. Building code provisions will be reviewed to the extent that they apply in this context.

Rules & Requirements

Prerequisites: CE W224C and CE W 224E

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Sitar, Mosalam

CIV ENG W224J Performance-Based Earthquake Engineering 2 Units
Fundamentals and evolution of Performance-Based Earthquake Engineering (PBEE). Probalilistic framework of PBEE. PBEE components: ground motion intensity measures, engineering demand parameters, damage measure, and decision variable. Multidisciplinary aspects of PBEE. Case studies of applications of PBEE.
Objectives & Outcomes

Course Objectives: The objective of this course is to bring together all of the concepts learned in previous and concurrent courses and develop an understanding of the methods of performance-based earthquake engineering. This is done through a series of modules that introduce the framework for performance-based earthquake engineering and also cover of the framework from seismology through decision-making. The assigned homework enables students to develop experience in using and combining these basic elements, finally bringing them together in a term project that serves as a demonstration of mastery in performance-based earthquake engineering.

Rules & Requirements

Prerequisites: CE W225E and CE W224F

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Bozorgnia, Mahin

CIV ENG 225 Dynamics of Structures 3 Units
Evaluation of deformations and forces in structures, idealized as single-degree of freedom or discrete-parameter multi-degree of freedom systems, due to dynamic forces. Evaluation of earthquake-induced deformations and forces in structures by linear response history analysis; estimation of maximum response by response spectrum analysis; effects of inelastic behavior. Laboratory demonstrations.
Rules & Requirements

Prerequisites: 220 (may be taken concurrently) or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Chopra

CIV ENG 226 Stochastic Structural Dynamics 3 Units
Introduction to the theory of probability and random processes. Correlation and power spectral density functions. Stochastic dynamic analysis of single- and multi-degree-of-freedom structures subjected to stationary and non-stationary random excitations. Time- and frequency-domain analyses; modal cross-correlations. Response to multi-support excitations. Level crossings, envelope process, first-excursion probability, and distributions of peaks and extremes. Introduction to nonlinear stochastic dynamic analysis. Applications in earthquake, wind, and ocean engineering.
Rules & Requirements

Prerequisites: 225

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Der Kiureghian

CIV ENG 227 Earthquake-Resistant Design 3 Units
Design of structures to resist earthquakes and other dynamic excitations. Characterization of earthquakes for design. Development of design criteria for elastic and inelastic structural response. Seismic performance of various structural systems. Prediction of nonlinear seismic behavior. Basis for code design procedures. Preliminary design of steel and reinforced concrete structures. Evaluation of earthquake vulnerability of existing structures and rehabilitation of seismic deficiencies.
Rules & Requirements

Prerequisites: 220 and 225

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Mahin, Moehle

CIV ENG 228 Advanced Earthquake Analysis 3 Units
Advanced topics in time-domain dynamic analysis of structures. Frequency-domain analysis of dynamic response; discrete Fourier transform methods. Earthquake analysis of structures including structural-foundation-soil interaction, and of structures interacting with fluids.
Rules & Requirements

Prerequisites: 225

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Chopra

CIV ENG 229 Structural System Reliability 3 Units
Review of probability theory. Multivariate distribution models. Review of classical methods for characterization of systems and assessment of system reliability. Formulation of structural reliability for components and systems. Exact solutions for special cases. Computational reliability methods, including first- and second-order reliability methods (FORM and SORM), response surface, Monte Carlo simulation, and importance sampling. Bounds on system reliability. Reliability sensitivity and importance measures. Bayesian updating and reliability analysis under statistical and model uncertainties. Introductions to reliability-based optimal design, time- and space-variant reliability analysis, and finite-element reliability methods.
Rules & Requirements

Prerequisites: Graduate standing

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Der Kiureghian

CIV ENG C231 Mechanics of Solids 3 Units
Mechanical response of materials: Simple tension in elastic, plastic and viscoelastic members. Continuum mechanics: The stress and strain tensors, equilibrium, compatibility. Three-dimensional elastic, plastic and viscoelastic problems. Thermal, transformation, and dealloying stresses. Applications: Plane problems, stress concentrations at defects, metal forming problems.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Credit Restrictions: Students will receive no credit for 231 after taking 231A or 231B prior to Fall 1992.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Govindjee

Also listed as: MAT SCI C211

CIV ENG 232 Structural Mechanics 3 Units
The goal of this course is to study the theories of structural mechanics within the framework of nonlinear continuum mechanics of solids. Finite elasticity; invariance. Energy principles: principles of virtual and complementary virtual work; primary and mixed variational principles. Theory of stability: Euler method; stability under follower loads. Classical theories of beams: planar, torsional, and lateral buckling. Plate theories. Invariant theories of structural mechanics: directed continua; Cosserat theories of rods.
Rules & Requirements

Prerequisites: 231 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Armero

CIV ENG 233 Computational Mechanics 3 Units
Computational methods for solution of problems in structural mechanics. Finite-element methods for displacement and mixed variational solutions of problems in elasticity and inelasticity. Treatment of constraints arising from near incompressibility in solids, transverse shear effects in beams, plates, and shells, and/or contact between structures. Programming methods for finite-element implementations.
Rules & Requirements

Prerequisites: 222, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Armero

CIV ENG 234 Computational Inelasticity 3 Units
Computational methods applied to inelastic deformations of solids; 1, 2, and 3-D large and small-deformation continuum plasticity and viscoelasticity models and their algorithmic approximations; viscoplastic regularizations and softening; thermodynamics and its relationship to algorithmic stability; return mappings, closest-point projections and operator splits; application to metals, soils, concrete, and polymers and incorporation into finite element codes.
Rules & Requirements

Prerequisites: 231 or Materials Science and Engineering 211 or Mechanical Engineering 185

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Armero, Govindjee

CIV ENG C235 Statistical Mechanics of Elasticity 3 Units
Introduction to statistical mechanics for engineers interested in the constitutive behavior of matter with a particular interest in continua. Systems of interest will be polymers and crystalline solids. Coverage includes introduction to statistical mechanics, ensembles, phase spaces, partitions functions, free energy, polymer chain statistics, polymer networks, harmonic and quasi-harmonic crystalline solids, limitations of classical methods and quantum mechanical influences.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Govindjee, Papadopoulos

Also listed as: MEC ENG C279

CIV ENG C236 Micromechanics 3 Units
Basic theories, analytical techniques, and mathematical foundations of micromechanics. It includes 1. physical micromechanics, such as mathematical theory of dislocation, and cohesive fracture models; 2. micro-elasticity that includes Eshelby's eigenstrain theory, comparison variational principles, and micro-crack/micro-cavity based damage theory; 3. theoretical composite material that includes the main methodologies in evaluating overall material properties; 4. meso-plasticity that includes meso-damage theory, and the crystal plasticity; 5. homogenization theory for materials with periodic structures.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Govindjee, Li

Also listed as: MAT SCI C214

CIV ENG C237 Computational Nano-mechanics 3 Units
Basic mathematics foundations, physical models, computational formulations and algorithms that are used in nanoscale simulations and modelings. They include (1) cohesive finite element methods and discontinuous Galerkin methods; (2) meshfree methods, partition of unity methods, and the eXtended finite element methods (X-FEM); (3) quasicontinuum method; (4) molecular dynamics; (5) multiscale simulations; (6) Boltzmann method.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Li

Also listed as: NSE C237

CIV ENG 240 Civil Engineering Materials 3 Units
Microstructures of concrete, wood, and steel. Differences and similarities in response to loading and environmental effects on these materials, with emphasis on strength, elastic properties, creep, shrinkage, thermal stresses, and failure mechanisms.
Rules & Requirements

Prerequisites: An undergraduate course in civil engineering materials

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Monteiro, Ostertag

CIV ENG 241 Concrete Technology 3 Units
Properties of fresh and hardened concrete; strength, elastic behavior, creep, shrinkage, and durability to chemical and physical attacks. New concrete-making materials. Recent advancements in concrete technology: high-strength, high-workability, and high-performance concrete; fiber-reinforced concrete, and roller-compacted concrete.
Rules & Requirements

Prerequisites: 165 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Monteiro

CIV ENG 244 Reinforced Concrete Structures 3 Units
Analysis and design of reinforced concrete elements and systems that are common in building and bridge structures, with an emphasis on seismic response and design; structural design methods; reinforced concrete materials; confined concrete; line elements under axial, flexural, and shear loadings; bond, anchorage, and development; seismic design principles; earthquake-resistant building frames, walls, diaphragms, and foundations; earthquake-resistant bridges.
Rules & Requirements

Prerequisites: 123

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Moehle

CIV ENG 245 Behavior of Reinforced Concrete 3 Units
Advanced topics in reinforced concrete construction, including inelastic flexural behavior; applications of plastic analysis to reinforced concrete frames; behavior in shear and torsion; yield-line analysis of slabs; behavior under cyclic and reversed loading; seismic rehabilitation.
Rules & Requirements

Prerequisites: 123 and 220

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Moehle

CIV ENG 246 Prestressed Concrete Structures 3 Units
Behavior and design of statically determinate prestressed concrete structures under bending moment, shear, torsion and axial load effects. Design of continous prestressed concrete beams, frames, slabs, and shells. Time-dependent effects and deflections of prestressed concrete structures. Applications to the design and construction of bridges and buildings.
Rules & Requirements

Prerequisites: 244 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Filippou, Moehle

CIV ENG 247 Design of Steel and Composite Structures 3 Units
Behavior and design of steel plate girders and shear walls. Design of bracings for stability. Design of members subjected to torsion. Design of composite beams, columns, and beam-columns. Behavior and design of shear, semi-rigid and moment connections. Concepts used in design of gusset plates and base plates. Selection and design of steel and composite systems.
Rules & Requirements

Prerequisites: 122 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Astaneh, Mahin

CIV ENG 248 Behavior and Plastic Design of Steel Structures 3 Units
Topics related to inelastic behavior and plastic design of steel members and structures. Behavior of plastic hinge in members subjected to bending moment, axial force, shear, and their combinations. Collapse mechanisms of steel members and structures such as moment frames and braced systems. Inelastic cyclic behavior of steel components. Introduction to fracture and fatigue of steel components.
Rules & Requirements

Prerequisites: 122 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Astaneh, Mahin, Stojadinovic

CIV ENG 249 Experimental Methods in Structural Engineering 3 Units
This course covers the following topics: similitude laws, design of structural models, instrumentation and measurement techniques; use of computers to acquire data and control tests; pseudo-dynamic testing method; standard proof-testing for capacity assessment; non-destructive testing for condition assessment, and virtual experimentation. Upon completing this course, the students will be able to use experimental methods to investigate the behavior of a structure and to evaluate its condition.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Stojadinovic, Mahin

CIV ENG C250N Transportation Policy and Planning 3 Units
Policy issues in urban transportation planning; measuring the performance of transportation systems; the transportation policy formulation process; transportation finance, pricing, and subsidy issues; energy and air quality in transportation; specialized transportation for elderly and disabled people; innovations in transportation policy.
Rules & Requirements

Prerequisites: 213 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Also listed as: CY PLAN C217

CIV ENG 251 Operation of Transportation Facilities 3 Units
The management of vehicle flows and fleets. Traffic stream properties and their measurement. Theories of traffic flow. Capacity analysis and queueing. Flow control and fleet scheduling.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Cassidy, Daganzo

CIV ENG 252 Systems Analysis in Transportation 3 Units
The systems approach and its application to transportation planning and engineering. Prediction of flows and level of service. Production functions and cost minimization. Utility theory and demand modeling. Transportation network analysis and equilibrium assignment. Decision analysis and evaluation of transportation projects.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Madanat

CIV ENG 253 Intelligent Transportation Systems 3 Units
The use of advanced surveillance, navigation, communication, and computer technology to monitor, analyze, and improve the performance of transportation systems. Enabling technologies. Application to monitoring, analysis, evaluation, and prediction of transportation system performance and behavior. Intervention strategies. Feasibility studies. Human factors and institutional issues. Case studies. In the laboratory, students carry out a term project under the supervision of an ITS researcher.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Sengupta, Skabardonis

CIV ENG 254 Transportation Economics 3 Units
Application of micro- and macro-economic concepts to transportation systems. Urban and interregional travel demand analysis. Freight demand. Project and program evaluation. Social welfare theory. Analysis of social cost. Investment analysis and pricing theory. Economic impact analysis. Role of economic analysis in decision making.
Rules & Requirements

Prerequisites: 252 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Hansen, Kanafani

CIV ENG 255 Highway Traffic Operations 3 Units
Operational planning and management of the highway transportation system. The highway system is presented as a set of operating environments with each having its unique analytical framework. Major topics to be covered include policy and institutional issues, selection of strategies and tactics, evaluation of objectives and measures of effectiveness.
Rules & Requirements

Prerequisites: 251 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Cassidy

CIV ENG 256 Transportation Sustainability 3 Units
This multi-disciplinary course is intended to introduce students to the fundamentals of sustainable transportation, with an emphasis on: 1) current trends, climate and energy science, and the policy context; 2) methodological and analysis techniques; 3) vehicle technology, fuels, and intelligent transportation systems (ITS) solutions (supply side); and 4) land use, public transportation, and demand management.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Horvath

CIV ENG 258 Logistics 3 Units
Vehicle routing. Transportation-inventory-production interrelationships, physical distribution networks, many-to-many networks (airlines, postal, etc.), the role of transshipments and terminals in logistic systems for the transportation of goods and passengers, public and private transportation system design. Relevant methodologies.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Daganzo

CIV ENG C258 Supply Chain and Logistics Management 3 Units
Supply chain analysis is the study of quantitative models that characterize various economic trade-offs in the supply chain. The field has made significant strides on both theoretical and practical fronts. On the theoretical front, supply chain analysis inspires new research ventures that blend operations research, game theory, and microeconomics. These ventures result in an unprecedented amalgamation of prescriptive, descriptive, and predictive models characteristic of each subfield. On the practical front, supply chain analysis offers solid foundations for strategic positioning, policy setting, and decision making.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Shen

Also listed as: IND ENG C253

CIV ENG 259 Public Transportation Systems 3 Units
Analysis of mass transit systems, their operation, and management. Technology of transit vehicles and structures. Public policy and financing.
Rules & Requirements

Prerequisites: 251, 252, and 262 (or equivalent course)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Cassidy, Daganzo, Madanat

CIV ENG 260 Air Transportation 3 Units
Nature of civil aviation; structure of the airline industry; aircraft characteristics and performance; aircraft noise; navigation and air traffic control; airport planning and design; airline operations; aviation system planning.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Hansen, Kanafani

CIV ENG 261 Infrastructure Systems Management 3 Units
Integrated treatment of quantitative and analytical methods for the management of infrastructure facilities over their life. The focus of the course is on statistical modeling and numerical optimization methods and their application to managing systems of civil infrastructure, with an emphasis on transportation facilities.
Rules & Requirements

Prerequisites: 252 or equivalent, 262 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Madanat

CIV ENG 262 Analysis of Transportation Data 3 Units
Probabilistic models in transportation. The use of field data. Data gathering techniques, sources of errors, considerations of sample size. Experiment design for demand forecasting and transportation operations analysis. Analysis techniques.
Rules & Requirements

Prerequisites: College calculus or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of session per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Daganzo, Hansen, Madanat

CIV ENG 263 Operations of Transportation Terminals 3 Units
Characteristics of terminals on a mode by mode basis (sea ports, railyards, airports, parking lots, etc.). Methodologies used to study terminal operations and the management of congestion. (Chronographs, input-output diagrams, pricing, simulation). Studies illustrating the use of the methodologies for different modes.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of session per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Daganzo

CIV ENG 263N Scalable Spatial Analytics 3 Units
Introduction to modern methods of data analysis, spatial data handling and visualization technologies for engineers and data scientists. Theoretical coverage includes a selection of methods from spatial statistics, exploratory data analysis, spatial data mining, discriminative and generative approaches of machine learning. Projects and assignment tasks are targeted at real-world scalable implementation of systems and services based on data analytics in environmental remote sensing, transportation, energy, location-based services and the domain of “smart cities” in general
Rules & Requirements

Prerequisites: Civil and Environmental Engineering 290I or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Pozdnukhov

CIV ENG 264 Behavioral Modeling for Engineering, Planning, and Policy Analysis 3 Units
Many aspects of engineering, planning, and policy involve a human element, be it consumers, businesses, governments, or other organizations. Effective design and management requires understanding this human response. This course focuses on behavioral theories and the use of quantitative methods to analyze human response. A mix of theory and practical tools are covered, with applications drawn from infrastructure investment and use, urban growth and design, health, and sustainability.
Rules & Requirements

Prerequisites: 262 or City and Regional Planning 204 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Walker

CIV ENG C265 Traffic Safety and Injury Control 3 Units
This course applies principles of engineering, behavioral science, and vision science to preventing traffic collisions and subsequent injury. A systematic approach to traffic safety will be presented in the course, and will include (1) human behavior, vehicle design, and roadway design as interacting approaches to preventing traffic crashes and (2) vehicle and roadway designs as approaches to preventing injury once a collision has occured. Implications of intelligent transportation system concepts for traffic safety will be discussed throughout the course.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Ragland

Also listed as: PB HLTH C285

CIV ENG 268A Lean Construction Concepts and Methods 3 Units
Inspired by the "lean" resolution in manufacturing, production management concepts and methods are woven into a lean project delivery system. Key concepts include flow, value, variability, and waste. Key methods include proecution system design, target costing, value stream mapping, and work flow control. Student teams apply concepts and methods in field studies of real project management processes and construction operations. The course includes a tour of the NUMMI Auto Plant in Fremont.
Rules & Requirements

Prerequisites: Graduate standing in Civil and Environmental Engineering

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Ballard

Formerly known as: 290M

CIV ENG 268B Lean Construction and Supply Chain Management 3 Units
Principles and practices of "lean" production are applied to project delivery in the AEC industry. Case studies illustrate the concepts. Project delivery is viewed holistically with a focus on work structuring and supply chain management. Topics include systems dynamics, uncertainty, and variation; materials management; logistics; e-commerce; building information modeling (BIM); and integrated product and process design. Students use process simulation to assess performance of different system configurations and develop a case study applying concepts on a real project.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Tommelein

Formerly known as: 290N

CIV ENG 268D Law for Engineers 3 Units
Engineering involves many parties with diverse interests. Legal principles form the framework for their interaction. Contracts for engineering services establish both risk allocation and reciprocal liabilities. Issues of contract formation, performance, breach, and remedy are covered in detail. Standard of care and professional negligence are emphasized during the discussion of tort law. Other topics include regulation, legal relationships, litigation, and alternative dispute resolution.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Formerly known as: 290L

CIV ENG 268E Civil Systems and the Environment 3 Units
Methods and tools for economic and environmental analysis of civil engineering systems. Focus on construction, transportation, and operation, and maintenance of the built infrastructure. Life-cycle planning, design, costing, financing, and environmental assessment. Industrial ecology, design for environment, pollution prevention, external costs. Models and software tools for life-cycle economic and environmental inventory, impact, and improvement analysis of civil engineering systems.
Rules & Requirements

Prerequisites: 166 or 167 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Horvath

CIV ENG 268H Advanced Project Planning and Control 3 Units
Cost and time estimating and controlling techniques for projects. Evaluation of labor, material, equipment, and subcontract resources, scheduling techniques, earned value concepts. Measuring project percent complete. Contractual risk allocation. Project investment analysis techniques.
Rules & Requirements

Prerequisites: 167

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Ibbs

CIV ENG 268I Business Fundamentals for Engineers 3 Units
This course will provide a broad survey of management practices critical to starting and managing a business in the engineering and construction industries. Topics that are covered include the entrepreneurial process; organizing and staffing; establishing and applying production control systems; means of protecting products and services from competitive threat; and financial management.
Rules & Requirements

Prerequisites: 167 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Ibbs

CIV ENG 268K Human and Organizational Factors: Quality and Reliability of Engineered Systems 3 Units
This course addresses human and organizational factors in development of desirable quality and reliabiltiy in engineered systems during their life-cyles (concept development through decommissioning). Applications tested and verified proactive, reactive, and interactive approaches are developed and illustrated.
Rules & Requirements

Prerequisites: Graduate standing

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Bea

Formerly known as: 290A

CIV ENG 270 Advanced Geomechanics 3 Units
Advanced treatment of topics in soil mechanics, including state of stress, consolidation and settlement analysis, shear strength of cohesionless and cohesive soils, and slope stability analysis.
Rules & Requirements

Prerequisites: 175 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Bray, Pestana, Seed

Formerly known as: 270A

CIV ENG 271 Sensors and Signal Interpretation 3 Units
An introduction to the fundamentals of sensor usage and signal processing, and their application to civil systems. In particular, the course focuses on how basic classes of sensors work, and how to go about choosing the best of the new MEMS-based devices for an application. The interpretation of the data focuses on analysis of transient signals, an area typically ignored in traditional signal processing courses. Goals include development of a critical understanding of the assumptions used in common sensing and analysis methods and their implications, strengths, and limitations.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Glaser

CIV ENG 272 Numerical Modelling in Geomechanics 3 Units
Constitutive laws for geotechnical materials including inelastic hyperbolic and elasto-plastic Cam-clay; soil behavior and critical-state soil mechanics; application of the finite element method to static analysis of earth structures; the Discontinuous Deformation Analysis method.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Bray, Pestana

CIV ENG 273 Advanced GeoEngineering Testing and Design 3 Units
Field and laboratory testing of soils to support analysis and design of earth structures. In situ field testing, including SPT, CPT, and vane shear, undisturbed sampling of soil, and laboratory testing of soil, including advanced equipment, instrumentation, data acquisition, and measurement techniques. Consolidation and static and cyclic triaxial and simple shear testing under stress- and strain-control with pore pressure measurements. Preparation of an engineering report.
Rules & Requirements

Prerequisites: 270 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Bray, Pestana, Seed

Formerly known as: 270L

CIV ENG 275 Geotechnical Earthquake Engineering 3 Units
Seismicity, influence of soil conditions on site response, seismic site response analysis, evaluation and modelling of dynamic soil properties, analysis of seismic soil-structure interaction, evaluation and mitigation of soil liquefaction and its consequences, seismic code provisions and practice, seismic earth pressures, seismic slope stability and deformation analysis, seismic safety of dams and embankments, seismic performance of pile foundations, and additional current topics.
Rules & Requirements

Prerequisites: 175 or equivalent, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Bray, Seed

CIV ENG C276 Seismic Hazard Analysis and Design Ground Motions 3 Units
Deterministic and probabilistic approaches for seismic hazard analysis. Separation of uncertainty into aleatory variability and epistemic uncertainty. Discussion of seismic source and ground motion characterization and hazard computation. Development of time histories for dynamic analyses of structures and seismic risk computation, including selection of ground motion parameters for estimating structural response, development of fragility curves, and methods for risk calculations.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Abrahamson

Also listed as: EPS C276

CIV ENG 277 Advanced Foundation Engineering 3 Units
Advanced treatment of topics in foundation engineering, including earth pressure theories, design of earth retaining structures, bearing capacity, ground improvement for foundation support, analysis and design of shallow and deep foundations.
Rules & Requirements

Prerequisites: 270 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Bray, Pestana, Seed

Formerly known as: 270B

CIV ENG 281 Engineering Geology 3 Units
Influence of geologic origin and history on the engineering characteristics of soils and rocks. Application of geology in exploration, design, and construction of engineering works.
Rules & Requirements

Prerequisites: A course in physical geology

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Sitar

CIV ENG 285C Seismic Methods in Applied Geophysics 3 Units
This course gives an overview of seismic methods used to image the subsurface. Acquisition, processing, and interpretation of seismic data are discussed, with application to petroleum production, environmental site characterization, earthquake engineering, and groundwater.
Rules & Requirements

Prerequisites: C178 or equivalent (introductory course in applied geophysics); Engineering 7 or 77 or equivalent (introductory course in computer programming)

Credit Restrictions: Students will receive no credit for 285C after taking Mineral Engineering 236 before Fall 2001.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Rector

Formerly known as: Mineral Engineering 236

CIV ENG 286 Digital Data Processing 3 Units
Considerations for digital signal processing and data analysis. Fourier Transforms, convolution and correlation. Discrete linear systems, Z tranforms. Digital processing of seismic reflection data, deconvolution and migration. Introduction to 3-D seismic data.
Rules & Requirements

Prerequisites: Consent of instructor

Credit Restrictions: Students will receive no credit for 286 after taking Mineral Engineering 240 taken before Fall 2001.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Rector

Formerly known as: Mineral Engineering 240

CIV ENG C289 Embedded System Design: Modeling, Analysis, and Synthesis 4 Units
Principles of embedded system design. Focus on design methodologies and foundations. Platform-based design and communication-based design and their relationship with design time, re-use, and performance. Models of computation and their use in design capture, manipulation, verification, and synthesis. Mapping into architecture and systems platforms. Performance estimation. Scheduling and real-time requirements. Synchronous languages and time-triggered protocols to simplify the design process.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Sangiovanni-Vincentelli

Formerly known as: Electrical Engineering C249/Civil and Environmental Engineering C289

Also listed as: EL ENG C249B

CIV ENG 290 Advanced Special Topics in Civil and Environmental Engineering 1 - 3 Units
This course covers current topics of interest in civil and environmental engineering. The course content may vary from semester to semester depending upon instructor.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

CIV ENG 290F Advanced Topics in Seismology 3 Units
Active areas of research in applied seismology. Subjects include: anisotropic and viscoelastic wave propagation, borehole seismology, crosswell seismology, including crosswell seismic tomography, vertical seismic profiling, reservoir monitoring including passive seismic methods.
Rules & Requirements

Prerequisites: Introductory course in seismology; 286 or Mineral Engineering 240

Repeat rules: Course may be repeated for credit with consent of instructor. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Rector

Formerly known as: Mineral Engineering 290C

CIV ENG 290I Civil Systems: Control and Information Management 3 Units
Mathematical methods and information technologies for controlling CEE systems. Emphasizes designing component organizations that interact with the world in real-time to control a large system. Methods applied to transportation operations, supply chains, and structures. Management of design complexity by hierarchical specification, systematic use of simulation and verification tools, semantics, polymorphism,information management services, and compilation from high-level design languages.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Sengupta

CIV ENG 290J Advanced Topics in Geotechnical Engineering 3 Units
Advanced treatment of developing areas of geomechanics and geotechnical earthquake engineering, including the development of generalized nonlinear soil constitutive models, new developments in soil dynamics and geotechnical earthquake engineering, soil improvement, geosynthetics and earth structures, and case studies of geotechnical problems.
Rules & Requirements

Prerequisites: Advanced graduate standing in Geoengineering

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of seminar per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Bray, Pestana, Seed

CIV ENG 290T Advanced Topics in Transportation Theory 1 Unit
Selected topics in the mathematical analysis of transportation systems. Topics will vary from year to year.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructors: Cassidy, Daganzo

CIV ENG C290U Transportation and Land Use Planning 3 Units
Examination of the interactions between transportation and land use systems; historical perspectives on transportation; characteristics of travel and demand estimation; evaluation of system performance; location theory; models of transportation and urban structure; empirical evidence of transportation-land use impacts; case study examinations.
Rules & Requirements

Prerequisites: 113A or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructors: Chatman, Cervero

Also listed as: CY PLAN C213

CIV ENG 291G Advanced Estimation, Control, and Optimization of Partial Differential Equations 3 Units
This course will cover advanced methods in estimation, control, and optimization of distributed parameter systems (partial differential equations in particular). The course builds on 291 and covers discrete methods relying on finite differencing such as quadratic programming for optimal control and variational data assimilation, (ensemble, extended) Kalman filtering. The course covers distributed transfer function analysis and frequency responses of PDEs, and characteristics-based stability analysis.
Rules & Requirements

Prerequisites: Civil and Environmental Engineering C291F/Electrical Engineering C291/Mechanical Engineering C236 or equivalent, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Bayen

CIV ENG C291F Control and Optimization of Distributed Parameters Systems 3 Units
Distributed systems and PDE models of physical phenomena (propagation of waves, network traffic, water distribution, fluid mechanics, electromagnetism, blood vessels, beams, road pavement, structures, etc.). Fundamental solution methods for PDEs: separation of variables, self-similar solutions, characteristics, numerical methods, spectral methods. Stability analysis. Adjoint-based optimization. Lyapunov stabilization. Differential flatness. Viability control. Hamilton-Jacobi-based control.
Rules & Requirements

Prerequisites: Engineering 77, Mathematics 54 (or equivalent), or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Also listed as: EL ENG C291/MEC ENG C236

CIV ENG 292A Technologies for Sustainable Societies 1 Unit
Exploration of selected important technologies that serve major societal needs, such as shelter, water, food, energy, and transportation, and waste management. How specific technologies or technological systems do or do not contribute to a move toward sustainability. Specific topics vary from year to year according to student and faculty interests.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of seminar per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructors: Horvath, Nazaroff

CIV ENG 295 Energy Systems and Control 3 Units
Introduction to energy system management and the underlying control system tools. Applications of interest include batteries, electric vehicles, renewable energy, power systems, and smart buildings/homes. Technical tools include system modeling, state-space representations, stability, parameter identification, state observers, feedback control, and optimization
Objectives & Outcomes

Course Objectives: This course provides an introduction to emerging smart energy systems and the associated fundamental concepts in control systems theory

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Letter grade.

Instructor: Moura

CIV ENG 297 Field Studies in Civil and Environmental Engineering 1 - 12 Units
Supervised experience in off-campus companies relevant to specific aspects and applications of civil and environmental engineering. Written report required at the end of the semester. Course does not satisfy unit or residence requirements for a master's or doctoral degree.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-12 hours of fieldwork per week

Summer:
6 weeks - 2.5-30 hours of fieldwork per week
8 weeks - 1.5-22.5 hours of fieldwork per week
10 weeks - 1.5-18 hours of fieldwork per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

CIV ENG 298 Group Studies, Seminars, or Group Research 1 - 6 Units
Advanced studies in various subjects through special seminars on annually selected topics, informal group studies of special problems, group participation in comprehensive design problems, or group research on complete problems for analysis and experimentation.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

CIV ENG 299 Individual Research 1 - 12 Units
Research or investigation in selected advanced subjects.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3-36 hours of independent study per week

Summer: 8 weeks - 6-68 hours of independent study per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

CIV ENG 301 Workshop for Future Civil and Environmental Engineering Teachers 1 - 3 Units
The course will include supervised teaching of laboratory sections of civil engineering courses, group analysis of videotapes, reciprocal classroom visitations, and an individual project.
Rules & Requirements

Prerequisites: Teaching assistant or graduate student status

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/ Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

CIV ENG 601 Individual Study for Master's Students 1 - 6 Units
Individual study for the comprehensive or language requirements in consultation with the major field adviser. Units may not be used to meet either unit or residence requirements.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.

CIV ENG 602 Individual Study for Doctoral Students 1 - 6 Units
Individual study in consultation with the major field adviser, intended to provide an opportunity for qualified students to prepare for the various examinations required of candidates for doctoral degrees. May not be used for unit or residence requirements.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Civil and Environmental Engineering/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.