

# California State University, Long Beach 2025-2026 Undergraduate and Graduate Catalog

## Courses

[Contract All Courses](#) |

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### Civil Engineering

#### **C E 101 - Introduction to Civil Engineering and Construction Engineering Management**

(1 unit)

Civil engineering and construction management as a profession. Current trends and challenges, ethical, social and environmental issues in professional practice. Professional organizations and licensure. Communication and lifelong learning skills for professional practice.

Letter grade only (A-F). (Lecture-problems 1 hour) Not open for credit to students with credit in: [C E 101H](#)

. Same Course as [C E 101H](#)

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#### **C E 101H - Introduction to Civil Engineering and Construction Engineering Management**

(1 unit)

Prerequisites: Engr Honors Program track I or II.

Civil engineering and construction engineering management as a profession. Current trends and challenges, ethical, social and environmental issues in professional practice. Professional organizations and licensure. Communication and lifelong learning skills for professional practice.

Letter grade only (A-F). (Lecture-problems 1 hour). Same course as [C E 101](#)

. Open to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in [C E 101](#)

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#### **C E 130 - Surveying and Mapping**

(1 unit)

Corequisite(s): [C E 130L](#)

and [MAE 172](#)  
or [MAE 172A](#)  
or [CEM 121](#)

Theory and practice of plane surveying, including the use of instruments for measuring distances, angles, and elevations. Plotting of surveying data and topographic mapping. Fundamentals of construction layout. Integration of data with surveying software.

Letter grade only (A-F). (Lecture-Problems 1 hour)

## **C E 130L - Surveying and Mapping Laboratory**

(1 unit)

Corequisite: [C E 130](#)

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Fundamentals of surveying methods as applied to construction layout. Use of level and total station for location and control of structures, vertical and horizontal control, and area determination.

Letter grade only (A-F). (Laboratory 3 hours) Not open for credit to students with credit in CE 131.

## **C E 200 - Materials for Civil Engineering**

(1 unit)

Prerequisites: [CHEM 111A](#)

and [PHYS 151](#)

all with a grade of "C" or better.

Corequisite: [C E 200L](#).

Basic properties of materials in civil engineering, including concrete, masonry, steel, wood, asphalt and composites.

Letter grade only (A-F). (Lecture 1 hour)

## **C E 200L - Materials for Civil Engineering Laboratory**

(1 unit)

Prerequisites: [CHEM 111A](#)  
and [PHYS 151](#)

all with a grade of "C" or better.

Corequisite: [C E 200](#)

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Laboratory testing of basic properties of materials in civil engineering, including concrete, masonry, steel, wood, asphalt, and composites.

Letter grade only (A-F). (Laboratory 3 hours)

## **C E 205 - Analytical Mechanics I (Statics)**

(3 units)

Prerequisite: [PHYS 151](#)  
with a grade of "C" or better.

Prerequisite/Corequisite: [MATH 123](#)

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Application of the mechanics of equilibrium to force systems using analytical and graphical solutions of problems involving structures and machines.

Letter grade only (A-F). (Lecture 2 hours, Activity 2 hours). Same course as [C E 205H](#)

. Not open for credit to students with credit in [C E 205H](#)

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## **C E 205H - Analytical Mechanics I (Statics)**

(3 units)

Prerequisite: [PHYS 151](#)  
with a grade of "C" or better.

Prerequisite/Corequisite: [MATH 123](#)

. EHP track I or track II.

Application of the mechanics of equilibrium to force systems using analytical and graphical solutions of problems involving structures and machines.

Letter grade only (A-F). (Lecture 2 hours, Activity 2 hours) CE 205H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in [C E 205](#)

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## **C E 206 - Computer Programming and Civil Engineering Applications I**

(1 unit)

Prerequisites: [MATH 122](#)  
, [PHYS 151](#)

all with a grade of "C" or better.

Corequisite: [C E 206L](#)

Introduction to programming and application of computers to elementary civil engineering problems.

Letter grade only (A-F). (Lecture-Problems 1 hour)

## **C E 206L - Computer Programming and Civil Engineering Applications Laboratory**

(1 unit)

Prerequisites: [MATH 122](#)  
, [PHYS 151](#)

all with a grade of "C" or better.

Corequisite: [C E 206](#)

Hands-on application of computers and programming to elementary civil engineering problems.

Letter grade only (A-F). (Laboratory 3 hours)

## **C E 307 - Probability and Statistics in Civil Engineering**

(2 units)

Prerequisites: [C E 206](#)

and CE 206L all with a grade of "C" or better.

Analysis of uncertainties, and applications of the basic theories of probability and statistics in civil engineering areas of geotechnical, environmental, water resources, structural and transportation engineering.

Letter grade only (A-F). (Lecture-problems 1 hour, Lab 3 hrs)

## **C E 325 - Transportation Safety and Sustainability**

(3 units)

Prerequisites: Completion of GE Foundation Requirements

Introduction to transportation systems and various modes of transportation: land, air, and water; legislations affecting transportation practices; transportation safety; impacts of transportation on the environment; sustainable transportation: transit, bicycles, and pedestrians.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 326 - GIS Laboratory for Civil Engineers**

(1 unit)

Prerequisites: [C E 130](#)

, [C E 130L](#)

, [C E 206](#), [CE 206L](#)

all with a grade of "C" or better.

Fundamentals of geographic information systems (GIS); spatial and network analyses. Hands-on application of GIS software to solve civil engineering problems.

Letter grade only (A-F). (Laboratory 3 hours)

## **C E 333 - Water, Engineering, and Society**

(3 units)

Prerequisites: Completion of at least 60 units.

Introduction to fundamental principles in hydrology and water resources engineering. Hydrologic cycle, water use, and water conveyance systems. Role of water and engineering in society. Impacts of climate and environmental change on water supply. Current water issues.

Letter grade only (A-F). (Lecture-Problems, 3 hours) Not repeatable for credit.

## **C E 335 - Fluid Mechanics**

(3 units)

Prerequisites: [MATH 224](#)

and [C E 205](#)

all with a grade of "C" or better.

Properties of fluids, fluid statics, fluid dynamics, dynamic similitude, flow of compressible and incompressible fluids in closed conduits.

Letter grade only (A-F). (Lecture-Problems 3 hours). Same course as [C E 335H](#)

. Not open for credit to students with credit in [C E 335H](#)

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## **C E 335H - Fluid Mechanics**

(3 units)

Prerequisites: [MATH 224](#)

and [C E 205](#)

or [C E 205H](#)

all with a grade of "C" or better. EHP track I or track II. Freshmen Excluded.

Properties of fluids, fluid statics, fluid dynamics, dynamic similitude, flow of compressible and incompressible fluids in closed conduits.

Letter grade only (A-F). (Lecture-problems 3 hours) CE 335H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in [C E 335](#).

## **C E 336 - Fluid Mechanics Laboratory**

(1 unit)

Prerequisite: [ENGL 100B](#)

or GE English Composition (Area 1A) all with a grade of "C" or better.

Prerequisite/Corequisite: [C E 335](#)

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Experiments in and study of the phenomena of fluid flow.

Letter grade only (A-F). (Laboratory 3 hours).

## **C E 345 - Introduction to Soil Mechanics**

(2 units)

Prerequisite: C E 205 with a grade of "C" or better.

Corequisites: MAE 373 and C E 345L.

Mechanical behavior of soil and the interaction between soil and water. Includes soil exploration, identification, classification, strength, compressibility.

Letter grade only (A-F). (Lecture-Problems 2 hours). Same course as C E 345H. Not open for credit to students with credit in C E 345H.

## **C E 345H - Introduction to Soil Mechanics**

(2 units)

Prerequisite: C E 205 with a grade of "C" or better. Engr Honors Program track I or II.

Corequisites: MAE 373 and C E 345L

Mechanical behavior of soil and the interaction between soil and water. Includes soil exploration, identification, classification, strength, compressibility

Letter grade only (A-F). (Lecture-problems 2 hours). Same course as C E 345. C E 345H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in C E 345.

## **C E 345L - Soil Mechanics Laboratory**

(1 unit)

Prerequisite: [C E 205](#)

with a grade of "C" or better.

Prerequisite/Corequisite: C E 345.

Laboratory investigation and experiments in the phenomena of soil mechanics.

Letter grade only (A-F). (Laboratory 3 hours).

## **C E 359 - Structural Analysis I**

(3 units)

Prerequisite: [MAE 373](#)

with a grade of "C" or better.

Analysis of structures including trusses, beams, and frames, conjugate beam, virtual work, energy methods, approximate methods, and influence lines. Use of code based finite element computer programs in analysis of frame and truss type structures.

Letter grade only (A-F). (Lecture-Discussion 2 Hours, Activity 2 Hours) Same course as [C E 359H](#). Not open for credit to students with credit in [C E 359H](#).

## **C E 359H - Structural Analysis I**

(3 units)

Prerequisite: [MAE 373](#)

or [MAE 373H](#)

with a grade of "C" or better. Engr Honors Program track I or II. Excluding Freshmen.

Analysis of structures including trusses, beams, and frames, conjugate beam, virtual work, energy

methods, approximate methods, and influence lines. Use of code based finite element computer programs in analysis of frame and truss type structures.

Letter grade only (A-F). (Lecture-Discussion 2 Hours, Activity 2 Hours). CE 359H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in [C E 359](#).

## **C E 364 - Environmental Engineering I: Fundamentals**

(2 units)

Prerequisite: CHEM 111A, BIOL 200 or BIOL 201 all with a grade of "C" or better.

Corequisite: C E 364L.

Prerequisite/Corequisite: C E 335.

Introduction to the fundamental physical, chemical and biological processes affecting air and water quality. Models of transport and transformation of impurities. Emphasis on theory underlying the design of water quality control technologies.

Letter grade only (A-F). (Lecture-Problems 2 hours). Same course as C E 364H. Not open for credit to students with credit in C E 364H.

## **C E 364H - Environmental Engineering I: Fundamentals**

(2 units)

Prerequisite: CHEM 111A, BIOL 200 or BIOL 201 all with a "C" or better. Engr Honors Program track I or II. Corequisite: C E 364L.

Prerequisite/Corequisite: C E 335.

Introduction to the fundamental physical, chemical and biological processes affecting air and water quality. Models of transport and transformation of impurities. Emphasis on theory underlying the design of water quality control technologies.

Letter grade only (A-F). (Lecture-Problems 2 hours) C E 364 CE 364H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in C E 364.

## **C E 364L - Environmental Engineering Laboratory**

(1 unit)

Prerequisites: [CHEM 111A](#)

and [BIOL 200](#)

/[BIOL 201](#)

all with a grade of "C" or better



Prerequisite/Corequisite: [C E 364](#)

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Experiments in routine water quality analysis and environmental engineering applications.

Letter grade only (A-F). (Laboratory 3 hours).

## **C E 404 - Laboratory Techniques**

(1 unit)

Prerequisites: [ENGL 100B](#)

or GE English Composition (Area 1A) with a grade of "C" or better, senior standing in Civil Engineering and consent of instructor.

Study the techniques of organizing and directing of the civil engineering laboratory.

Letter grade only (A-F). (Conference 1 hour, Laboratory 3 hours). May be repeated to maximum of 3 units.

## **C E 405 - Selected Topics in Civil Engineering**

(3 units)

Prerequisites: Senior standing in civil engineering and consent of instructor.

Selected topics from recent advances in civil engineering. Course content will vary from year to year.

Letter grade only (A-F). (Lecture-Problems 3 hours) May be repeated to a maximum of 6 units. Topics announced in *Schedule of Classes*.

## **C E 406 - Project Cost-Benefit Analysis**

(3 units)

Prerequisites: Completion of at least 60 units, completion of the entire Foundation, and completion of at least one GE Course from the Explorations stage.

Systematic evaluation of the economic and social benefits and costs of projects. Decision-making in an environment of limited resources, environmental and economic constraints, and uncertainty. The economy of multi-year projects, selection among competing independent alternatives, before and after-tax analyses, replacement economy and inflation.

Letter grade only (A-F). (Lecture-Problems 3 hours). Same course as [C E 406H](#)

. Not open for credit to students with credit in [C E 406H](#)

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## **C E 406H - Project Cost-Benefit Analysis**

(3 units)

Completion of at least 60 units, completion of the entire Foundation, and completion of at least one GE Course from the Explorations stage. Engr Honors Program track I or II. Excludes Freshmen or Sophomores.

Systematic evaluation of the economic and social benefits and costs of projects. Decision-making in an environment of limited resources, environmental and economic constraints, and uncertainty. The economy of multi-year projects, selection among competing independent alternatives, before and after-tax analyses, replacement economy and inflation.

Letter grade only (A-F). (Lecture-Problems 3 hours) CE 406H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in [C E 406](#).

## **C E 426 - Transportation Engineering**

(3 units)

Prerequisites: C E 325, C E 345, and CE 345L all with a grade of "C" or better.

Corequisite: C E 406.

Integrative learning course on transportation engineering. Characteristics of driver, pedestrian, vehicle, and road; traffic flow; intersection design and control, planning, and geometric design; safety issues. Team project, oral presentations, and written reports required.

Letter grade only (A-F). (Lecture-Discussion 3 hours). Same course as C E 426H. Not open for credit to students with credit in C E 426H.

## **C E 426H - Transportation Engineering**

(3 units)

Prerequisites: C E 325, C E 345, and C E 345L all with a grade of "C" or better.

Corequisite: [C E 406](#)

and Engr Honors Program track I or II.

Integrative learning course on transportation engineering. Characteristics of driver, pedestrian, vehicle, and road; traffic flow; intersection design and control, planning, and geometric design; safety issues. Team project, oral presentations, and written reports required.

Letter grade only (A-F). (Lecture-Discussion 3 hours) C E 426 CE 426H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in C E 426.

## **C E 427 - Highway Design**

(2 units)

Prerequisite: [C E 345](#)

with a grade of "C" or better.

Corequisite: [C E 427L](#)

Geometric design of highways and streets. Route location and earthwork computation. Introduction to roadside and pavement design. Design problems in highway engineering.

Letter grade only (A-F). (Lecture-Problems 2 hours)

## **C E 427L - Highway Design Laboratory**

(1 unit)

Corequisite: [C E 427](#)

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Geometric highway design project, horizontal alignment, vertical alignment, cross section, earthwork calculation, environmental impact, use of software application.

Letter grade only (A-F). (Laboratory 3 hours)

## **C E 428 - Highway Engineering Materials**

(2 units)

Prerequisites: [C E 200](#)

and [C E 345](#)

all with a grade of "C" or better.

Corequisite: [C E 428L](#)

Design and properties of highway materials, including aggregates, asphalt binder, and mixtures. Hot Mix Asphalt (HMA) aggregate gradation, blending procedure, volumetrics, design, plant operation, and lay down. Superpave binder testing and specifications.

Letter grade only (A-F). (Lecture 2 hours)

## **C E 428L - Highway Engineering Materials Laboratory**

(1 unit)

Corequisite: [C E 428](#)

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Laboratory testing for aggregate, asphalt binder, and asphalt concrete mixture.

Letter grade only (A-F). (Laboratory 3 hours)

## **C E 429 - Traffic Engineering**

(2 units)

Corequisite: [C E 426](#)  
, [C E 429L](#)

Capacity and level of service analyses of highway facilities. Intersection signal timing design. Introduction to traffic control devices. Volume, speed, and delay studies. Use of traffic data for design, planning, and operational levels of analyses.

Letter grade only (A-F). Graduate students are required to do extra projects. (Lecture-Problems 3 hours)

## **C E 429L - Traffic Engineering Laboratory**

(1 unit)

Corequisites: [C E 426](#)  
, [C E 429](#)

Laboratory activities on traffic flow theory, capacity and level of service analyses, signal timing, parking lot design, and travel demand forecasting; traffic volume, speed, and delay studies. Use of traffic engineering software.

Letter grade only (A-F). (Laboratory 3 hours) Not open for credit to students with credit in CE 430.

## **C E 435 - Hydrology and Water Resources Engineering**

(3 units)

Prerequisite: [C E 335](#)  
with a grade of "C" or better.

Fundamental surface and ground water hydrology concepts and quantitative methods. Selected topics and procedures of the hydrological cycle. Planning, development, and management of water resource surface systems.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 437 - Engineering Hydraulics**

(3 units)

Prerequisites: [C E 335](#)  
, [MATH 370A](#)  
all with a grade of "C" or better.

Analysis of steady flow in pipe and pipeline networks, and centrifugal pump systems. Theory and analysis of uniform and non-uniform flow in open conduits. Design of lined and unlined channels, computations of critical, gradual, and rapidly varied flows.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 438 - Hydraulic Engineering Design I**

(2 units)

Corequisite: [C E 438L](#)

Prerequisite/Corequisite: C E 437

Application of hydraulic principles to the design of dams, water courses, water systems and their related structures and devices.

Letter grade only (A-F). (Lecture 2 hours)

## **C E 438L - Hydraulic Design I Laboratory**

(1 unit)

Corequisite: [C E 438](#)

Prerequisite/Corequisite: C E 437.

Computer laboratory applications to the design of water courses, water systems and their related structures and devices

Letter grade only (A-F). (Laboratory 3 hours)

## **C E 439 - Fundamentals of Groundwater Flow and Contaminant Transport**

(3 units)

Corequisite: [C E 437](#)

Introduction to principles of groundwater flow and contaminant transport. Groundwater remediation methods. Mathematical description of flow and transport in the subsurface with software applications.

Letter grade only (A-F). (Lecture-Discussion 3 hours)

## **C E 445 - Introduction to Foundation Engineering**

(3 units)

Prerequisites: [C E 345](#)

with a grade of "C" or better.

Design of shallow and deep foundation structures. Site investigation and evaluation of soil conditions. Soil and strength evaluation. Bearing capacity and settlement theory and calculations.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 446 - Geotechnical Walls and Slopes in Heavy Civil Engineering**

(3 units)

Prerequisite: [C E 345](#)

with a grade of "C" or better.

Design and problem solving for retaining walls and slope stability in Heavy Civil projects. Theory of earth pressures behind structures utilizing soil mechanics theory. Theory of slope stability, including shear strength, design charts, and limit equilibrium analysis.

Letter grade only (A-F). (Lecture-Problems 3 hours). Graduate students are required to do additional readings and write a research term paper to deal with current topics in geotechnical engineering.

## **C E 447 - Introduction to Geotechnical Earthquake**

(3 units)

Prerequisite: [C E 345](#)

with a grade of "C" or better

Introduction to analysis of geotechnical projects undergoing earthquake loading. Including soil dynamics theory, soil liquefaction, slope stability, retaining structures, and site response.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 455 - Structural Steel Design**

(3 units)

Prerequisite: [C E 359](#)

with a grade of "C" or better.

Detailed design of components with typical codes and specifications.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 456 - Timber Design**

(3 units)

Prerequisite: [C E 359](#)

with a grade of "C" or better.

Design of various structural elements made of wood material subjected to both vertical and lateral loads. Application of current building codes and specifications in timber design.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 458 - Structural Analysis II**

(3 units)

Prerequisite: [C E 359](#)

with a grade of "C" or better.

Solution of indeterminate truss and frame structures using moment distribution and slope deflection methods. Introduction to matrix methods. Energy theorems and virtual work principles. Use of code based finite element computer programs in the analysis of indeterminate structural systems.

Letter grade only (A-F). (Lecture-Discussion 2 Hours, Activity 2 Hours)

## **C E 459 - Reinforced Concrete Design I**

(3 units)

Prerequisites: [C E 200](#), [C E 200L](#),

and C E 359 all with a grade of "C" or better.

Material properties of concrete and steel comprising a reinforced concrete element. Code compliant and design of reinforced concrete elements including beams, columns, one-way slabs, and footing.

Letter grade only (A-F). (Lecture 2 hours, Laboratory 3 hours)

## **C E 464 - Environmental Engineering II: Unit Processes**

(3 units)

Prerequisites: [C E 335](#)

, [C E 364](#)

, and [C E 364L](#)

all with a grade of "C" or better.

Civil engineering applications of the fundamentals of chemical reactions, kinetics of biochemical systems, gas transfer systems, liquid/solid separations, solubility equilibria, adsorption, ion exchange and membrane processes.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 466 - Environmental Systems Design**

(3 units)

Prerequisite: [C E 335](#)

, [C E 364](#)

, and [C E 364L](#)

with a grade of "C" or better.

Design principles of water treatment and water reclamation facilities.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 481 - Professional Practice in Civil Engineering**

(1 unit)

Prerequisite: C E 101 or ENV 101 with a grade of "C" or better and senior standing.

Topics related to the practice of the civil engineering profession. Professional society meetings and readings.

Letter grade only (A-F). (Lecture-Problems 1 hour)

## **C E 490 - Senior Design Project**

(3 units)

Prerequisites: Completion of all 300-level engineering courses for the civil engineering major all with a grade of "C" or better and consent of department undergraduate advisor.

Prerequisite(s)/Corequisite(s): [C E 426](#)

, [C E 437](#)

, and [C E 459](#)

. Completion of at least 60 units, completion of the entire Foundation, and completion of at least one GE Course from the Explorations stage.



Capstone design that fulfills integrative capstone design course. A supervised design team project, incorporating all aspects from concept to completed design. Technical aspects, social, environmental, and economic issues considered. Ethical concepts discussed. Oral presentations and written reports are required.

Letter grade only (A-F). (Lecture-Problems 2 hrs, Design lab 3 hrs)

## **C E 495 - Seismic Design I**

(3 units)

Prerequisite(s)/Corequisite(s): C E 459.

Elements of lateral-force design in steel, concrete, masonry, and timber structures. Application of current building codes.

Letter grade only (A-F). (Lecture-Discussion 2 Hours, Laboratory 3 Hours)

## **C E 500 - Engineering Analysis I**

(3 units)

Prerequisites: Open to Civil Engineering and Engineering MS students only.

Application of analytical methods to engineering problems. Differential equations and series solutions, Bessel functions and Legendre polynomials, boundary value and eigenvalue problems, Fourier series, partial differential equations, vector analysis.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 501 - Engineering Analysis II**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Analysis of engineering mechanics by matrix theory and complex variables; introduction to numerical techniques.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 502 - Finite Element Method and Applications**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Introduction of the theory of finite element method and its application to mechanics of structures and solids. Variational calculus, discretization of continuum, discrete element stiffness matrices, displacement and force vector, direct stiffness formulation, and solution methods for linear equations.

Letter grading only (A-F). (Lecture-Problems 3 hours)

### **C E 503 - Selected Topics in Civil Engineering**

(3 units)

Prerequisites: Open to Civil Engineering MS and Engineering MS students only.

Selected topics, with laboratory work required, from the most recent developments in civil engineering.

Letter grade only (A-F). (Lecture-Problems 2 hours, Laboratory 3 hrs) May be repeated to a maximum of 6 units. Topics announced in the *Schedule of Classes*. No more than 6 units of CE 503 or [C E 504](#) may be counted for the master's degree.

### **C E 504 - Selected Topics in Civil Engineering**

(3 units)

Prerequisite: Open to Civil Engineering MS, Construction Management MS, and Engineering MS students only.

Selected topics from recent developments in civil engineering.

Letter grade only (A-F). (Lecture-Problems 3 hrs) May be repeated to a maximum of 6 units. Topics announced in the *Schedule of Classes*. No more than 6 units of C E 503 and/or CE 504 may be counted for the master's degree.

### **C E 508 - Mathematics in Engineering: Probabilistic and Statistical Methods**

(3 units)

Prerequisite: Open to MS Civil Engineering, MS Construction Management and MS Engineering students only.

Civil Engineering applications of nondeterministic models and decision theory. Applications of proven statistical computer programs.

Letter grade only (A-F). (Lecture-Problems 3 hours)

### **C E 509 - Mathematics in Engineering: Computational Methods**

(3 units)

Prerequisite: Open to Civil Engineering MS or Engineering MS students only.

Numerical analysis and computer methods applied to various areas of civil engineering. Application of proven computer methods, including special problem-oriented languages.

Letter grade only (A-F). (Seminar 3 hrs)

## **C E 516 - Timber Design II**

(3 units)

Prerequisite: Open to Civil Engineering and Engineering MS students only.

Structural behavior of timber buildings/ wood structures under seismic load. Analysis/ design of nonrectangular buildings, horizontal diaphragms and shearwalls. Analysis/ design of member under biaxial bending and axial force. Load/ resistance factor design (LRFD) for wood construction. Current building codes/ specifications in advanced timber design.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 517 - Reinforced Masonry Design**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Theory, design, and application of reinforced masonry (brick and block) in compliance with the latest Building Code. Earthquake provisions. Construction and specifications. Design of high-rise buildings, industrial buildings and retaining walls. Graduate students are required to do a design project and assigned readings from journals and research papers.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 520 - Seaport Planning and Design**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Planning and design of seaports and facilities as access systems. Support transportation, use analysis and ocean transport crafts. Site selection and comprehensive planning.

Letter grade only (A-F) (Lecture-Problems 3 hours).

## **C E 522 - Advanced Analysis: Transportation Planning**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Planning of transportation facilities in urban setting; application of travel forecasting and analytical models in the planning process; evaluation of transportation alternatives and impacts; transportation system and demand management techniques.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 526 - Advanced Design: Pavement Engineering**

(3 units)

Prerequisite: [C E 426](#)

or equivalent. Open to Civil Engineering MS and Engineering MS students only.

Aggregate, binder systems. Theory and design of pavement structures.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 528 - Engineering in Society: Advanced Highway Materials**

(3 units)

Prerequisite: [C E 426](#)

. Open to Civil Engineering MS and Engineering MS students only.

Hot mix asphalt design methods and lay down methods. Distress identification and rehabilitation procedures of highway materials.

Letter grade only (A-F). (Lecture-Discussion 3 hours).

## **C E 529 - Advanced Technologies: Traffic Engineering**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Analysis of arterial streets traffic operations. Queuing Analysis; Signal timing coordination and optimization; Use of traffic optimization and simulation computer models to solve problems.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 530 - Advanced Technologies: Groundwater Flow: Principles and Modeling**

(3 units)

Prerequisite: Graduate Standing.

Principles of water flow in the saturated and unsaturated zone. Well hydraulics. Numerical modeling of groundwater flow in the subsurface with computer applications. Groundwater artificial recharge and saline water intrusion.

Letter grade only (A-F). (Lecture 3 hrs).

## **C E 532 - Sediment Transportation**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Phenomena of sediment transportation related to streams and marine environments.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 533 - Groundwater Contaminant Transport: Principles and Modeling**

(3 units)

Prerequisites: Open to Civil Engineering MS and Engineering MS students only.

Mechanisms of contaminant transport in groundwater. Analysis of groundwater remediation methods and alternatives. Numerical modeling of flow and transport in the subsurface. Software applications.

Letter grade only (A-F). (Lecture 3 hrs).

## **C E 534 - Data Analysis for Hydrologic and Water Resources Applications**

(3 units)

Prerequisite(s): Graduate Standing.

Principles and applications of hydrology and water resources data analysis. Hydrologic analysis, statistics, and physically based methods for hydrologic and climate data analysis and modeling. Presentation, discussion, and analysis of drivers and impacts of climate change, extreme events, and environmental change.

Letter grade only (A-F). (Lecture-Problems, 3 hours) Not repeatable for credit.

## **C E 535 - Advanced Analysis: Hydrology**

(3 units)

Prerequisite: Graduate Standing.

Theory and application of surface hydrology. Advanced study of hydrologic processes and

interactions in the terrestrial system. Physical process and watershed analysis with mathematical models and simulation.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 536 - Urban Surface Water Management**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Planning and design of facilities to control flooding, erosion, sedimentation, and non-point source pollution for urban storm water runoff management. Presentation of analysis and design methodologies, structural and non-structural measures for management, and master planning principles.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 538 - Hydraulic Engineering Design II**

(3 units)

Prerequisites: Open to Civil Engineering MS and Engineering MS students only

Design of water supply networks, hydraulic transitions, controls, and structures. Hydraulic power conversion. River engineering. Water resources systems.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 546 - Advanced Design: Foundation Engineering**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Foundation, explorations, stress and deformation relationships and design of various footings, piles, piers, and caissons. Analysis of lateral loads and design of retaining structures, machinery foundations and foundation dewatering.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 547 - Advanced Technologies: Geotechnical Earthquake Engineering**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Theory and behavior of dynamically loaded soil. Analysis, design, and mitigation of geotechnical projects subjected to earthquake loading. Topics include soil liquefaction, slope stability, retaining structures, and site response analysis.

Letter grade only (A-F). (Lecture-Problems 3 hours).

### **C E 548 - Advanced Analysis: Soil Mechanics**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Stress-strain time relationship of soils. Theory and methods of analysis with special emphasis on the applications and limitations in soil engineering.

Letter grade only (A-F). (Lecture-Problems 3 hours).

### **C E 549 - Engineering in Society: Retaining Structures and Slope Stability**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Theory of earth pressures, retaining structures, design of retaining walls, sheet piles, mechanically stabilized earth, soil nails, anchored and braced excavation. Theory of slope stability, including shear strength, design charts, limit equilibrium analysis, seepage analysis, staged construction, and rapid drawdown.

Letter grade only (A-F). (Lecture-Problems 3 hours).

### **C E 551 - Advanced Design: Reinforced Concrete Structures**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Behavior, analysis, and design of elements and systems that are common in building structures including pre-stressed slabs/decks, reinforced concrete frames, walls, columns, diaphragms, and foundations. Emphasis is on seismic design aspects, although other considerations will be included.

Letter grade only (A-F). (Lecture-Problems 3 hours).

### **C E 553 - Behavior and Design of Steel Structures**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Study of torsion, unsymmetrical bending, stability. Plastic design, code provisions and commentary. Design of complete structural systems in steel.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 554 - Analysis and Design with Composite Materials**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Mechanics of composite materials with design applications in aerospace, civil engineering, and construction. Lab experiments on composite samples. Project required with canned computer programs.

Letter grade only (A-F). (Lecture-Problems 3 hrs)

## **C E 555 - Engineering in Society: Earthquake Engineering**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Advanced computational methods to evaluate responses of structural systems subjected to earthquake ground motions. Time-history and response spectrum analysis for various structural systems. Innovative earthquake design of buildings and other structures.

Letter grading only (A-F). (Lecture-Problems 3 hours)

## **C E 557 - Advanced Analysis: Structural Analysis**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Virtual forces and displacements, strain energy and complementary energy. Force and displacement matrix methods. Computer applications to planar and space frames, trusses, floor beams and shear wall systems.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 558 - Advanced Technologies: Dynamics of Structures**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Response of structures and structural components having one or more degrees of freedom. Damping and inelastic action; earthquake and nuclear blasts, dynamic resistance of structural elements and structures, elastic, and inelastic response of structures.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 562 - Engineering in Society: Water Treatment Systems**



(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Design of physical and chemical processes for water treatment plants, intake stations, predisinfection units, rapid mixing tanks, slow mixing tanks, clarifiers, granular filtration tanks and post disinfection basins, hydraulics profiles, equipment lists and control systems.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 563 - Advanced Design: Wastewater Treatment Systems**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Design of physical and chemical biological processes for wastewater treatment, including primary, secondary, and tertiary treatment combined with hydraulics profiles, equipment lists and control systems at the plants.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 564 - Environmental Health Engineering**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

Health and safety aspects of environmental quality and related engineering systems. Regulatory aspects. Projects and case studies.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 568 - Renewable Resources and Energy**

(3 units)

Prerequisites: Open to Civil Engineering and Engineering MS students only.

Renewable resources, energy-harvesting technologies, sustainable utilizations, and integrated systems. Technical aspects, policy, economic, social, environmental issues, engineering challenges and availability and limitations of natural resources.

Letter grade only (A-F).

## **C E 570 - Engineering Management Principles and Practices**

(3 units)

Prerequisites: Open to Civil Engineering MS, Construction Management MS, and Engineering MS

students only.

Transition of engineers into management. Analysis of technical manager's functions at lower and middle levels as support to corporate management. Principles of engineering management and applications to private and public sector organizations. Case studies of practices in different technical organizations.

Letter grade only (A-F). (Lecture 3 hours).

## **C E 571 - Construction Planning and Cost Control**

(3 units)

Prerequisite: Open to Civil Engineering MS, Construction Management MS, and Engineering MS students only.

Planning, scheduling, and resource allocation for a complex construction project. Topics include traditional critical path method, advanced computer expert systems and optimization techniques for construction planning and cost control.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 573 - Engineering Specifications, Law, and Contracts**

(3 units)

Prerequisite: Open to Civil Engineering MS, Construction Management MS, and Engineering MS students only.

Application of law of contracts to construction contracts. Legal matters of concern to engineers.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 574 - Methods, Analysis and Design of Construction Operations**

(3 units)

Prerequisite: Open to Civil Engineering MS, Construction Management MS, and Engineering MS students only.

Equipment, methods, analysis, and design of a construction operation, from site work improvement and data acquisition to modeling and design. Particular attention will be paid to interfering between design and construction activities and work method development, productivity, and safety.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 575 - Advanced Analysis: Construction Optimization and Decision Making**

(3 units)

Prerequisite: Open to Civil Engineering MS and Engineering MS students only.

The course focuses on the latest research developments in optimizing and decision making of heavy civil infrastructure projects including bid decisions; contractor and material supplier selection; site layout planning; tradeoffs among time, cost, quality, and sustainability; repetitive construction scheduling.

Letter grade only (A-F).

## **C E 576 - Construction Organization and Management**

(3 units)

Prerequisite: Open to Civil Engineering, Construction Management MS, and Engineering MS students only.

An introduction to construction organization, control concepts and labor, emphasizing the business aspects of construction management. Topics include legal framework, finance in construction management, labor, accounting, and other decision making in the construction business.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 581 - Engineering in Society: Sustainability and Green Construction**

(3 units)

Prerequisite: Open to Civil Engineering MS, Construction Management MS, and Engineering MS students only.

Comprehensive coverage of the green building design and construction practices through high-performance, market-leading design, construction, and operation practices. Presents the green operations and management of new construction and major renovation projects, with emphasis on green building rating systems.

Letter grade only (A-F). (Lecture 3 hours)

## **C E 582 - Management of Productivity and Quality**

(3 units)

Prerequisite: Open to Civil Engineering MS, Construction Management MS, and Engineering MS students only.

System approaches to quality and productivity in construction. Total Quality Management (TQM) in construction and management. Investigation of methods and strategies for improving competitiveness at the company level. Domestic and international competitiveness in the construction business.

Letter grade only (A-F). (Lecture-Problems 3 hours)

## **C E 585 - Advanced Technologies: Utility Rehabilitation and Construction**

(3 units)

Prerequisite: Open to Civil Engineering MS, Construction Management MS, and Engineering MS students only.

State of infrastructure systems with a focus on underground facilities, diagnostic and evaluation techniques of underground utility pipes, planning, equipment, materials and methods for rehabilitation and construction of sewer and water mains using Trenchless (i.e., NO-DIG) Technology.

Letter grade only (A-F). (Lecture-Problems 3 hours).

## **C E 696 - Research Methods**

(1 unit)

Prerequisite: Advancement to candidacy for degree of Master of Science in Civil Engineering, or consent of instructor.

Bibliographical and library techniques and resources. Preparation and presentation of theses and directed studies technical papers.

Letter grade only (A-F).

## **C E 697 - Directed Studies**

(3 units)

Prerequisites: Advancement to candidacy for one of the following degrees MSCE, MSE, or MSCM and consent of directed studies faculty advisor.

Significant project appropriate to the area of specialization, resulting in a written design or research report including the project's significance, objectives, methodology, and a conclusion or recommendation. It evidences independent thinking, appropriate form, organization, and rationale.

Letter grade only (A-F).