C E-CIVIL ENGINEERING (C E)

C E 109. Computer Drafting Fundamentals
3 Credits (2+2P)
Same as DRFT 109, E T 109, SUR 109.

C E 151. Introduction to Civil Engineering
3 Credits
Problem solving and use of computer software for civil engineering applications.
Prerequisite(s): ENGR 100.
Corequisite(s): MATH 190.

C E 198. Special Topics
1-3 Credits
May be repeated for a maximum of 6 credits.
Prerequisite: consent of department head.

C E 233. Mechanics-Statics
3 Credits
Engineering mechanics using vector methods.
Prerequisites: MATH 192G and cumulative GPA of 2.0.
Corequisite: PHYS 215G.

C E 234. Mechanics-Dynamics
3 Credits
Kinematics and dynamic behavior of solid bodies utilizing vector methods.
Prerequisite(s): C E 233, MATH 192G, PHYS 215G.

C E 256. Environmental Engineering and Science
3 Credits
Principles in environmental engineering and science: physical chemical systems and biological processes as applied to pollution control. Crosslisted with: E S 256
Prerequisite(s): CHEM 111 and MATH 191G.

C E 256 L. Environmental Science Laboratory
1 Credit
Laboratory experiments associated with the material presented in C E 256. Same as E S 256L.
Corequisite: C E 256.

C E 298. Special Topics
1-3 Credits
May be repeated for a maximum of 6 credits.
Prerequisite: consent of department head.

C E 301. Mechanics of Materials
3 Credits
Stress, strain, and elasticity of materials.
Prerequisite: C E 233.

C E 311. Civil Engineering Materials
3 Credits (2+3P)
Introduction to the structure, physical properties, testing and mechanical behavior of civil engineering materials and components made from these materials.
Prerequisite: C E 301.

C E 315. Structural Analysis
4 Credits (3+3P)
Classical analysis of determinate and indeterminate structures; introduction to modern methods of structural analysis using computer programs.
Prerequisite(s): C E 301.

C E 331. Fluid Mechanics and Hydraulics
3 Credits
Prerequisite(s): PHYS 215, C E 233.

C E 331 L. Fluid Mechanics and Hydraulics Laboratory
1 Credit
Fundamentals and Theory of Fluid Mechanic, compressible and incompressible flow of fluids in open and closed conduits.
Prerequisite(s)/Corequisite(s): C E 331. Restricted to: C E majors.

C E 355V. Technology and the Global Environment
3 Credits
A scientific basis for understanding changes in the global environment that result through the complex interactions of natural phenomena and the impacts of the activities of man.
Prerequisites: junior or senior standing, and the general education requirements for math and natural sciences.

C E 356. Fundamentals of Environmental Engineering
3 Credits
Introduction to water treatment and water pollution and the analysis and design of selected treatment processes.
Prerequisite(s): C E 256.

C E 357. Soil Mechanics
3 Credits (2+3P)
Engineering properties of soils, consolidation settlement, compaction, water flow through soils, geostatic stresses, soil shear strength, lateral earth pressure, and soil laboratory testing.
Prerequisite(s): C E 160 or GEOL 111G, and C E 301.

C E 365. Intermediate Structural Analysis
1 Credit
Classical analysis of indeterminate structure; introduction to matrix method of structural analysis.
Prerequisite(s): C E 301 and C E 315.

C E 382. Hydraulic and Hydrologic Engineering
3 Credits
Analysis and design of hydraulic systems, including pipe networks, open channels, regulating structures, and pumping systems. Surface water and groundwater hydrology, analysis and design. May be repeated up to 3 credits.
Prerequisite(s): C E 331 and C E 331 L.

C E 398. Special Topics
1-3 Credits
May be repeated for a maximum of 6 credits.
Prerequisite: consent of department head.

C E 430. Environmental Management Seminar II
1 Credit
Survey of practical and new developments in environmental management field, hazardous and radioactive, waste management, and related health issues, provided through a series of guest lectures and reports of ongoing research. Restricted to: Main campus only. Crosslisted with: CH E 430, E E 430, E S 430, E T 430, I E 430, M E 430 and WERC 430

C E 444. Elements of Steel Design
3 Credits
Analysis and design of tension members, beams, columns, and bolted and welded connections.
Prerequisite(s)/Corequisite(s): C E 311. Prerequisite(s): C E 315.
C E 445. Reinforced Concrete Design
3 Credits
Design and mechanics of structural reinforced concrete members.
Prerequisite(s)/Corequisite(s): C E 311. Prerequisite(s): C E 315.

C E 452. Geohydrology
3-4 Credits (3+1P)
Origin, occurrence, and movement of fluids in porous media and
assessment of aquifer characteristics. Development and conservation of
ground water resources, design of well fields. Crosslisted with: E S 452
and GEOL 452.
Prerequisite(s): Junior or Senior.

C E 454. Wood Design
3 Credits
Theory and design of wood structural members and systems subjected to
gravity and lateral loads. Taught every other year, alternates with C E 455,
Masonry Design.
Prerequisite(s)/Corequisite(s): C E 311. Prerequisite(s): C E 315.

C E 455. Masonry Design
3 Credits
Theory and design of masonry structural members and systems
subjected to gravity and lateral loads. Taught every other year, alternates with C E 454, Wood Design.
Prerequisite(s)/Corequisite(s): C E 311. Prerequisite(s): C E 315.

C E 457. Foundation Design
3 Credits (2+3P)
Application of principles of classical soil mechanics to the design of
shallow and deep foundations, and the fundamentals of geotechnical site
investigation.
Prerequisite(s): C E 357.

C E 460. Site Investigation
3 Credits (2+2P)
Investigation and characterization of surficial and subsurface geologic
materials and ground water for civil engineering projects. Includes
exploration program, drilling and sampling, rock and soil classification
and logging, groundwater monitoring, profiles, and preparation of
technical reports. Pre/
Prerequisite(s): C E 357.
Corequisite(s): C E 457.

C E 469. Structural Systems
3 Credits
Design of structural systems for buildings and bridges. May be repeated
up to 3 credits.
Prerequisite(s): C E 444 or C E 445 or C E 457.

C E 470. Design of Municipal and Hazardous Waste Landfills
3 Credits
Solid waste and application of geotechnical engineering principles and
methods to the site selection and design of municipal and hazardous
waste landfills.
Prerequisite(s): C E 357 and C E 452, or consent of instructor.

C E 471. Transportation Engineering
3 Credits
Highway and traffic design and systems.
Prerequisite(s): MATH 291.

C E 473. Transportation Analysis
3 Credits
Transportation analysis of land-based transportation modes. Crosslisted
with: C E 573.
Prerequisite(s): C E 471.

3 Credits
Engineering economics, construction and project management.
Prerequisite(s): STAT 371.
Corequisite(s): C E 357.

C E 479. Pavement Analysis and Design
3 Credits
Covers stresses and deflections in pavement layers, material
characterization, flexible and rigid pavement design by AASHTO, and
rehabilitation concepts.
Prerequisite(s): C E 357.

C E 481. Civil Engineering Capstone Design
3 Credits
Culminating multidisciplinary project-oriented capstone design. Ethics,
professional development, global issues.
Prerequisite(s)/Corequisite(s): C E 457, C E 471, C E 477. Prerequisite(s): C E 356, C E 382, and either C E 444 or C E 445.

C E 482. Hydraulic Structures
3 Credits
Engineering design of water-regulating structures. Capstone design
course. May be repeated up to 3 credits.
Prerequisite(s)/Corequisite(s): C E 477. Prerequisite(s): C E 382.

C E 483. Surface Water Hydrology
3 Credits
Hydrologic cycle and relationships between rainfall and surface water
runoff.
Prerequisite: C E 331 or consent of instructor.

C E 485. Design of Earth Dams
3 Credits
Engineering design applied to site selection, foundation inspection and
treatment, hydrology and hydraulics, stability, and seepage analysis.
Economic and environmental factors.
Prerequisite(s): C E 357.

C E 498. Special Topics
1-3 Credits
May be repeated for a maximum of 9 credits.
Prerequisite: consent of department head.

C E 501. Advanced Mechanics of Materials
3 Credits
Study of stress and strain in two and three dimensions, theories of failure,
stress concentrations, unsymmetrical bending, curved beams, beams on
elastic foundations, column theories, torsion, thick-wall cylinders. Same
as M E 501.
Prerequisites: C E 301, MATH 392.

C E 502. Advanced Mechanics of Steel Structures
3 Credits
Advanced structural mechanics applicable to steel structures. Includes
inelastic behavior, plastic analysis, column and frame stability and
torsion.
Prerequisite: C E 444.

C E 503. Special Design and Analysis Program
3-6 Credits
Design and analysis covering subject matter of an approved 450
undergraduate departmental course plus an additional report or project.
Course may be subtitled in the Schedule of Classes. May be repeated
once for a total of 6 credits.
Prerequisite: consent of instructor/committee.
C E 504. Advanced Engineering Design
3 Credits
Advanced engineering design covering subject matter of a selected capstone undergraduate design course plus an additional report or project. May be subtitled.
Prerequisite: consent of instructor/committee.

C E 505. Advanced Mechanics of Concrete
3 Credits
Advanced structural mechanics applicable to concrete structures. Topics include: nonlinear-inelastic modeling and analysis of reinforced concrete structures, seismic behavior of reinforced concrete structures, and deformation of members under various loads. To be taught along with C E 405.

Prerequisite(s): C E 445.

C E 506. Advanced Soil Mechanics
3 Credits
Stress and strain analyses in soil, stress paths; drained and undrained shear strengths of granular soils and clays, consolidation, liquefaction, soil improvement.
Prerequisite: C E 457 or consent of instructor.

C E 507. Design of Earth Retaining Structures
3 Credits
Lateral earth pressure theory, soil-reinforcement interaction, and analysis and design of rigid and flexible earth retaining structures for support of fills and excavations, including retaining walls, mechanically stabilized earth (MSE) walls, sheet pile walls, anchored walls, tiebacks and soil nailing. Pre/
Prerequisite(s): C E 357.
Corequisite(s): C E 457.

C E 508. Advanced Soil Behavior
3 Credits
The course covers particle-scale phenomena that govern the macro-scale behavior of soils. Topics covered in the class include classical concepts as well as contemporary advances in soil mechanics. The students will develop a fundamental understanding of soil-water interaction, theories of contact level deformation, and mass and energy transport through granular media. Consent of Instructor required.
Prerequisite(s): C E 357 or Instructor Consent.

C E 509. Deep Foundations
3 Credits
Behavior, analysis and design of pile and pier foundations subjected to axial and lateral loads.
Prerequisite: C E 457 or consent of instructor.

C E 515. Finite Element Methods
3 Credits
Introduces the finite element method. Topics may include beam, frame, plane stress, plane strain, axisymmetric, and 3-D stress elements. Includes static and dynamic analysis. Uses readily available finite-element software.
Prerequisite: graduate standing or consent of instructor.

C E 530. Environmental Management Seminar I
1 Credit
Survey of practical and new developments in hazardous and radioactive waste management provided through a series of guest lectures and reports of ongoing research.

C E 531. Open Channel Hydraulics
3 Credits
Theoretical and applied hydraulics of open channels, with emphasis on nonuniform flow, rapidly varied flow, and wave formation.
Prerequisite: C E 382 or consent of instructor.

C E 543. Advances in Concrete Technology
3 Credits
Advanced topics related to concrete materials, including mixture proportioning with nontraditional admixtures, roles and side effects of concrete admixtures, durability of concrete, nondestructive testing of concrete, creep, and shrinkage.
Prerequisites: C E 311 and C E 445.

C E 544. Advanced Design of Steel Structures
3 Credits
Connection design; beam, column, and beam-column stability and design; and seismic frame design.
Prerequisites: C E 444 and C E 468.

C E 545. Advanced Concrete Design
3 Credits
Prestressed concrete, ultimate strength theory, design of shell structures.
Prerequisites: C E 445 and C E 468.

C E 547. Bridge Engineering
3 Credits
Topics related to prestressed concrete, reinforced concrete and steel bridge design according to the AASHTO specifications; bridge analysis and evaluation. May be repeated for a maximum of 6 credits.
Prerequisite: C E 469 or consent of instructor.

C E 550. Environmental Management Seminar II
1 Credit
Survey of practical and new developments in hazardous and radioactive waste management provided through a series of guest lectures and reports of ongoing research.

C E 554. Wood Design
3 Credits
Theory and design of wood structural members and systems subjected to gravity and lateral loads. Design project required. Taught every other year, alternates with C E 555 - Masonry Design.

C E 555. Masonry Design
3 Credits
Theory and design of masonry structural members and systems subjected to gravity and lateral loads. Design project required. Taught every other year, alternates with C E 554 - Wood Design.

C E 557. Water Resources Development
3 Credits
Students function as members of a consulting panel and prepare reports on major water resources development problems. Political, financial, and social aspects of water resources development are considered as well as scientific and technical details. Background: C E 450.
Corequisite: C E 483, or C E 482.

C E 571. Structural Dynamics
3 Credits
Response of elastic structure to dynamic loading. Moving load, earthquake and blast loading.
Prerequisite: C E 468 or consent of instructor.
C E 572. Earthquake Engineering
3 Credits
Earthquake characteristics; seismic loads; elastic and inelastic response; analysis and design of buildings for earthquakes.
Prerequisites: graduate standing and consent of instructor.

C E 573. Transportation Analysis
3 Credits
Transportation analysis of land-based transportation modes. Crosslisted with: C E 473.
Prerequisite(s): C E 471.

C E 577. Advanced Pavement Analysis
3 Credits
Review of advanced constitutive models for pavement materials and their implementation in finite element analysis.
Prerequisite(s): C E 479 and C E 515 or consent of instructor.

C E 579. Ground Improvement
3 Credits
The objective of this course is to introduce common ground improvement techniques, including mechanical (compaction, soil reinforcement, preloading and accelerated consolidation) and chemical (cementing, ion-replacement, polymer bonding) stabilization methods, as well as seepage and dewatering. Emphasis will be placed on developing an understanding of the underlying physical and chemical processes involved in each case.
Prerequisite(s): C E 357.

C E 581. Ground Water Hydrology
3 Credits
Mathematical treatment of water flow in porous media. Emphasis on hydraulics of water movement, including pumping and recharge wells, drainage, and water quality.
Prerequisites: MATH 392, G EN 452, and C E 382, or consent of instructor.

C E 582. Statistical Hydrology
3 Credits
Application of statistical techniques to hydrologic data, including distributions, hypothesis testing, linear models, non-parametrics, and time-series and stochastic models.

C E 585. Slope Stability Analysis and Design
3 Credits
Design of earth slopes, causes of instability, limit equilibrium methods, slope reinforcement (geosynthetics soil nailing, tiebacks), seismic analysis, rock slope stability. Consent of instructor required.

C E 586. Geotechnical Earthquake Engineering
3 Credits
Earthquake origin and geology; wave propagation; dynamic soil properties; ground response analysis; local site effects; design ground motion; liquefaction assessment. Consent of Instructor required.
Prerequisite(s): C E 506 or consent of instructor.

C E 596. Special Topics
1-3 Credits
May be repeated for a maximum of 6 credits.
Prerequisite: consent of department head.

C E 598. Special Research Programs
1-3 Credits
Individual investigations either analytical or experimental. May be subtitled. Maximum of 3 credits per semester.

C E 599. Master's Thesis
15 Credits
Thesis.

C E 600. Doctoral Research
1-15 Credits
Research.

C E 604. Advanced Engineering Topics
3 Credits
In depth study of a topic at the forefront of environmental engineering & science. Journal papers will be critically reviewed and students will be asked to write an analysis of the topic and present their thoughts orally.

C E 615. Advanced Finite Element Methods
3 Credits
Finite element method with emphasis on stress analysis. May include development and use of plane stress, plane strain, and 3-D and shell elements. Includes static, dynamic, and nonlinear analysis.
Prerequisite: graduate standing.

C E 645. Prestressed Concrete
3 Credits
Behavior of prestressed concrete; design of statically determinate and indeterminate structures; estimation of prestress loss; flexure and shear strength; deflections and stress control; composite behavior and design.
Prerequisites: graduate standing and consent of instructor.

C E 671. Scientific Approaches to Transportation Research
3 Credits
This course addresses professional and ethical practices for doing, managing, and evaluating research programs and projects. Students will learn about the critical elements in the research process, turning research objectives into research hypotheses, testing of the hypotheses and evaluation of the results. The course will look at the scientific method as well as the management and handling of data as it applies to transportation research. Consent of Instructor required.
Prerequisite(s): C E 471.

C E 682. Topics in Hydrodynamics II
3 Credits
Selected topics in flow-in open channels, flow-through porous media, and transport of sediments and contaminants. May be repeated for a maximum of 6 credits.
Prerequisite: consent of instructor.

C E 698. Special Research Programs
1-3 Credits
May be subtitled. May be repeated for a maximum of 9 credits.

C E 700. Doctoral Dissertation
15 Credits
Dissertation.