Introduction to Civil and Environmental Engineering

Department of Civil and Environmental Engineering

College of Engineering

221 Statics
Fall, Spring, Summer. 3(2-2) Interdepartmental with Mechanical Engineering. Administered by Civil Engineering. P: (PHY 183 or PHY 183B or PHY 193H) or (PHY 231 and PHY 233B) and ((MTH 234 or concurrently) or (LB 220 or concurrently) or (MTH 254H or concurrently)) SA: MSM 205 Vector description of forces and moments. Two- and three-dimensional equilibrium of particles and rigid bodies. Analysis of trusses, frames, and machines. Coulomb friction.

271 Introduction to Civil and Environmental Engineering
Fall, Spring. 4(3-3) P: (ME 222 and (CE 271 or concurrently)) and (CE 272 or concurrently) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering and open to juniors or seniors in the Biosystems Engineering major. Engineering properties of soil and their measurement. Effective-stress concept. Permeability and seepage. Compaction. Consolidation, shear strength, and stress-strain behavior.

272 Civil and Environmental Engineering Analysis
Fall, Spring. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: ((MTH 132 or concurrently) or (MTH 152H or concurrently)) or (LB 118 or concurrently) or (CE 271 or concurrently) Measurement, analysis, and design with applications in civil engineering. Surveying and error analysis.

280 Principles of Environmental Engineering and Science
Fall, Spring. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: (CEM 141 or CEM 151 or LB 171) and ((MTH 132 or concurrently) or (MTH 152H or concurrently)) or (LB 118 or concurrently) or (CE 271 or concurrently) Basic operations in AutoCAD. Selected applications of probability and statistics to topics in civil and environmental engineering. Applications of engineering economics including interest, present worth, benefit-cost analysis, comparison of economic alternatives, and life-cycle costing.

305 Introduction to Structural Analysis
Fall, Spring. 3(3-0) P: ME 222 and (CE 271 or concurrently) and (CE 272 or concurrently) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering. Theory of structural analysis for statically determinate structures. Qualitative structural analysis and behavior. Load estimation and placement. Introduction to structural analysis computer software. Introduction to statically indeterminate structures.

312 Soil Mechanics
Fall, Spring. 4(3-3) P: (ME 222 and (CE 271 or concurrently)) and (CE 272 or concurrently) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering and open to juniors or seniors in the Biosystems Engineering major. Engineering properties of soil and their measurement. Effective-stress concept. Permeability and seepage. Compaction. Consolidation, shear strength, and stress-strain behavior.

321 Introduction to Fluid Mechanics
Fall, Spring. 4(3-3) P: (MTH 234 or MTH 254H or LB 220) and CE 221 and ((ME 230 or concurrently) or (CE 271 or concurrently) or (CE 272 or concurrently)) and completion of Tier I writing requirement) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering or in the Biosystems Engineering major. Not open to students with credit in ME 332 Fluid properties, fluid statics, fluids in motion. Conservation of mass, energy, and momentum. Dimensional analysis and similarity. Internal and external flows. Applications.

337 Civil Engineering Materials I
Fall, Spring. 4(3-3) P: (ME 222 or concurrently) and (CE 271 or concurrently) and (CE 272 or concurrently) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering. Common civil engineering construction and paving materials: aggregates, inorganic cements, asphalts, concretes, wood, and steel. Composition, structure, physical and mechanical properties, tests, and production mix design.

341 Transportation Engineering
Fall, Spring. 3(3-0) P: (MTH 234 or concurrently) or (MTH 254H or concurrently) or (LB 220 or concurrently) and ((CE 271 or concurrently) and (CE 272 or concurrently)) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering. Overview of transportation system issues and problems. Fundamentals of highway design and operation. Planning and evaluation of transportation system alternatives.

342 Geotechnical Engineering
Fall. 3(2-2) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: CE 312 and (GLG 201 or GLG 301) R: Open to juniors or seniors or graduate students in the College of Engineering. Shallow foundation design: bearing capacity, stress distribution, and settlement analysis. Pile foundations. Design of retaining structures, including rigid walls, braced excavations, and sheet-pile walls. Stability of slopes and embankments.

343 Pavement Design and Analysis
Fall. 3(2-2) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: CE 321 and CE 421 and (CE 422 or concurrently) R: Open to students in the Department of Civil and Environmental Engineering and open to students in the Department of Biosystems and Agricultural Engineering. Project-based work using HEC-RAS and geographic information systems (GIS) to analyze the impacts of land use changes in urban and rural watersheds; design of systems to mitigate specific impacts. Project-based work on water distribution networks, analysis using EPANET to study the use of water storage towers, pressure regulation devices, and cyclic demands.

400 Structural Mechanics
Fall. 3(3-0) P: CE 305 R: Open to seniors or graduate students in the College of Engineering. Matrix methods of structural analysis. Flexibility method. Direct stiffness method for plane structures. Elastic supports, inclined supports, member releasees and non-prismatic members. Application software.

405 Design of Steel Structures
Fall. 3(3-0) P: CE 305 R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Design of steel beams, columns, tension members and connections. Stability and plastic strength.

406 Design of Concrete Structures
Spring. 3(3-0) P: CE 306 and CE 337 R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering. Design of reinforced concrete beams, slabs, columns and footings.
Civil Engineering—CE

444 Principles of Traffic Engineering
Fall. 3(3-0) P: STT 351 and CE 341 R: Open only to juniors or seniors or graduate students in the Civil Engineering major.

Driver and vehicle characteristics affecting traffic flow and safety. Speed, density, capacity relationships. Signal control in street networks. Freeway management systems. Risk management and liability.

448 Transportation Planning
Spring. 3(3-0) P: CE 341


449 Highway Design
Fall. 3(3-0) P: CE 341 R: Open to juniors or seniors or graduate students in the College of Engineering.

Geometric design of highways. Operation, capacity, safety, and geometric features. Alignment, drainage and pavement design. Use of CAD systems in preparing contract plans.

461 Computational Methods in Civil Engineering
Spring. 3(3-2) P: (CSE 131 or EGR 102) and (CE 221 and MTH 235) R: Open to juniors or seniors or graduate students in the Civil Engineering major. SA: CE 390 Not open to students with credit in ME 361.

Theoretical, numerical, and computational methods for civil engineering problems. Physical modeling, numerical techniques, and programming methods. Focus on civil engineering dynamics, solving systems of differential equations, and visualizing the results.

471 Construction Engineering - Equipment, Methods and Planning
Spring. 3(3-0) P: (CE 305 and CE 312 and CE 337) or (CMP 305 and CMP 322) R: Open to juniors or seniors or graduate students in the College of Engineering or in the Department of Management or in the Construction Management major.

Engineering and construction fundamentals of earthwork operations, moving of materials, concrete construction, formwork, false work, and other temporary structures. Relationship to a construction project's constructability, cost, and schedule.

480 Environmental Measurements Laboratory
Fall. 1(0-0) P: (CE 305 and CE 312 and CE 337) or (CMP 305 and CMP 322) R: Open to juniors or seniors or graduate students in the College of Engineering or in the Department of Management or in the Construction Management major.

Basic chemical and microbiological methods used in the analysis of environmental media. Laboratory safety, quality assurance, quality control, and statistics used in laboratory analysis. Related technical communication, laboratory report writing.

481 Environmental Chemistry: Equilibrium Concepts
Fall. 3(3-0) P: (CE 141 and CEM 142) or (CEM 151 and CEM 152) or (CEM 181H and CEM 182H) or (LB 171 and LB 172) R: Open to seniors or graduate students in the College of Engineering.

Chemistry of natural environmental systems. Environmental engineering, design and transportation. Equilibrium concepts and calculations for acid-base, solubility, complexation, redox and phase partitioning reactions and processes. Applications to ecosystem analysis, pollutant fate and transport, and environmental protection.

483 Unit Operations and Processes in Environmental Engineering
Fall. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: CE 280 and CE 321 or CEM 400 (currently).

Scientific basis and design of physical, chemical and biological treatment methods for the control of water and air pollution. Operation and process selection.

485 Landfill Design
Spring. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: CE 280 and CE 312 Geotechnical and environmental design of solid waste landfills.

487 Microbiology for Environmental Science and Engineering
Spring. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: CE 280

Fundamentals of microbiology. Application of these concepts to environmental processes such as wastewater treatment, human health and bioremediation.

490 Independent Study
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

Civil engineering problem of specific interest to the student and a faculty member. May be analysis or design.

492 Selected Topics in Civil Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

Selected topics related to construction engineering, environmental engineering, fluid mechanics, geotechnical engineering, hydrology, pavements, structural engineering, or transportation engineering.

495 Senior Design in Civil and Environmental Engineering
Fall, Spring. 4(2-3) R: Approval of department.


800 Bridge Design
Spring of odd years. 3(3-0) R: CE 400 and CE 405 and CE 406 and CE 312 and CE 806 R: Open to graduate students in the College of Engineering or approval of department.

Design and analysis of bridge structures including bridge types, materials, load conditions, construction, methods, and rehabilitation. Analysis of beam-slab, box girder, curved, and skewed bridges. Conceptual or preliminary design of a bridge project.

801 Nonlinear Structural Mechanics
Spring of odd years. 3(3-0) R: Basic knowledge on the design of steel (CE405) and concrete structures (CE406), matrix methods of structural analysis (CE400), background in differential equations.

Theory and methods related to the nonlinear behavior and analysis of structures with focus on line-type elements in two dimensions. Inelastic behavior of structural materials. Stability of structures. Nonlinear behavior and analysis of members and structural systems. Methods for iterative solution strategies and use of special computer software.

802 Introduction to Dynamics and Earthquake Engineering
Fall. 2 credits. R: MSM 306 Not open to students with credit in ME 461.


803 Structural Dynamics
Fall. 1(1-0) C. CE 802 concurrently.


804 Advanced Mechanics for Civil Infrastructure
Fall. 3(3-0) R: (CE 400) or matrix structural analysis R: Open only to graduate students in the College of Engineering.


805 Advanced Design of Steel Structures
Spring. 3(3-0)

Flexural and torsional instability of columns and beams. Slender cross-sectional elements, design of beam-columns. Torsion, plastic design, plate girders, composite steel-concrete construction, connections.

806 Advanced Structural Concrete Design
Spring of even years. 3(3-0) SA: CE 808

Analysis and design of prestressed and conventionally reinforced concrete structures.

807 Seismic Structural Design
Spring of even years. 3(3-0) R: CE 400 and CE 405 and CE 406 Theory and methods for the seismic design of buildings, bridges and other structures. Emphasis on fundamental factors influencing and controlling structural response. Philosophies for ductile design, capacity design and performance-based design. Analysis of structural systems under seismic demands for design and assessment. Introduction to retrofit strategies.
808 Structural Fire Engineering  
Spring of even years. 3(3-0) RB: CE 400 and CE 405 and CE 406  
Fire safety, fire codes, and fire engineering design methods. High temperature material properties, and behavior of materials and structures exposed to fires. Fire resistance design of steel, concrete, composite and timber structures. Use of the computer program for thermal and structural analysis.

809 Advanced Composite Materials and Structures  
Spring of even years. 3(3-0) RB: ME 222 and CE 490 and CSE 231 and MTH 235 and MTH 314  

810 Reliability-Based Design in Civil Engineering  
Fall. 3(3-0)  
Reliability of engineering systems. Reliability basis of design specifications, reliability of fires, floods, material properties, and capacity. Reliability basis of design specifications, reliability index, probability of failure, design for reliability. Reliability of engineering systems.

811 Advanced Hydrogeology  
Spring. 3(3-0) Interdepartmental with Geological Sciences. Administered by Geological Sciences. RB: CE 821  
Processes influencing groundwater flow and solute transport. Mathematical equations and numerical methods to describe these processes.

812 Properties of Soils  
Fall of odd years. 3(2-3)  
Saturated and unsaturated hydraulic properties, consolidation and shear strength properties, thermal properties, and numerical modeling. Laboratory determination of soil properties including, interpretation of experimental data.

813 Soil Dynamics  
Fall. 1(1-0) SA: CE 803B C: CE 802 concurr.  

815 Selected Topics in Geotechnical Engineering  
Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. Selected topics related to soil stabilization, highway and airport soils, and frozen ground engineering.

818 Advanced Geotechnical Design  
Spring. 3(3-0)  

821 Groundwater Hydraulics  
Fall. 3(3-5) Interdepartmental with Environmental Engineering. Administered by Civil Engineering.  

822 Groundwater Modeling  

823 Stochastic Groundwater Modeling  

829 Mixing and Transport in Surface Waters  

831 Advanced Concrete Pavement Analysis and Design  
Spring of odd years. 3(3-0) RB: CE 312 and CE 337 and CE 431  

832 Advanced Asphalt Pavement Analysis and Design  
Spring of even years. 3(3-0) RB: CE 312 and CE 337 and CE 431  
Mechanistic approach to asphalt pavement design. Analysis of asphalt pavement systems using theoretical models, asphalt material modeling, prediction, and performance. Formulation of improved mechanistic structural and mix design procedures.

835 Engineering Management of Pavement Networks  
Spring of even years. 3(3-0)  

836 Materials Science for Civil Engineers  
Fall. 3(3-0) RB: (CE 337) or equivalent  
Structure of materials and structure-property relationships in concrete materials. Control of concrete structure and properties for different infrastructural applications.

837 Advanced Concrete Materials  
Spring of odd years. 3(3-0) Microstructure, engineering characteristics and modeling of concrete materials. Structure-property relationships in concrete materials. Control of concrete structure and properties for different infrastructural applications.

843 Simulation and Optimization of Urban Traffic Flow  
Fall of even years. 3(3-0) RB: CE 444 and CE 841  
Assumptions behind and use of traffic signal optimization models as tools for the development of signal timing plans for isolated intersections and coordinated networks. Principles of vehicle actuation and design of actuated timing plans using signal optimization models. Simulation studies. Calibration issues with the use of microscopic traffic simulation models.

846 Transportation Policies and Decision-Making  
Fall of even years. 3(3-0)  
National transportation issues, policy formulation, and decision-making. Highway needs assessment, urban and statewide planning, revenue sources, cost allocation, and transportation funding programs.

847 Traffic Analysis and Control  
Spring of odd years. 3(3-0) P: CE 444 RB: Graduate student in transportation engineering. Modern traffic control and traffic modeling using state-of-the-art algorithms and computer models. Practical implications.

852 Analysis and Optimization of Civil Engineering Systems with Soft Computing  
Spring of odd years. 3(3-0) R: Open to students in the College of Engineering. Introduction to soft component techniques including neural networks, genetic algorithms, fuzzy logic, and neuro-fuzzy systems. Application to modeling analysis, and optimization of complex civil engineering problems. Theory, selection of suitable soft computing techniques, and proper application.

861 Introduction to Risk and Reliability in Civil and Environmental Engineering  
Fall. 1(1-0) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. Not open to students with credit in CE 810. Characterization of variability using probabilistic and statistical methods.

862 Reliability-Based Design in Civil Engineering  
Fall of odd years. 2(2-0) Not open to students with credit in CE 810. C: CE 861 concurrently. Probabilistic treatment of live and dead loads: earthquakes, floods, material properties, and capacity. Reliability basis of design specifications, reliability index, probability of failure, design for reliability. Reliability of engineering systems.

863 Applied Numerical Methods for Civil and Environmental Engineers  
Spring. 1 credit. Not open to students with credit in ENE 801. Computation, visualization and programming tasks in civil and environmental engineering.
872  Finite Element Method
Fall, Spring. 3(3-0) Interdepartmental with Mechanical Engineering. Administered by Mechanical Engineering. SA: AE 809, MSM 809
Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics, and stress analysis.

880  Civil Engineering Seminar
Fall, Spring. 1(1-0) A student may earn a maximum of 2 credits in all enrollments for this course. RB: Graduate student or undergraduate at senior level with a GPA of 3.0 or higher
Current research in civil engineering.

890  Independent Study in Civil Engineering
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. RB: Graduate student or undergraduate at senior level with a GPA of 3.0 or higher
Research problems of limited scope not pertaining to thesis accomplished under CE 899 or CE 999.

891  Selected Topics in Civil Engineering
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course.
Selected topics in new or developing areas of civil engineering.

892  Master's Research Project
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 5 credits in all enrollments for this course. R: Open only to master's students in the Civil Engineering major. Approval of department.
Master's degree Plan B individual student research project. Original research, research replication, or survey and reporting on a research topic.

893  Master's Design Project
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Open only to master's students in the Civil Engineering major. Approval of department.
Master's degree Plan B individual student civil engineering design project.

899  Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course.
Master's thesis research.

900  Research Strategies and Methods in Civil Engineering
Spring. 1(1-0) R: Open to graduate students in the Department of Civil and Environmental Engineering. Not open to students with credit in ENE 900.
Criteria for quality research, scientific method, scientific arguments, statistical testing, critical thinking skills, reviewing journal articles, literature synthesis, writing proposals and papers, giving presentations, responsible conduct of research.

990  Independent Study in Civil Engineering
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course.
Research problems of limited scope not pertaining to thesis accomplished under CE 899.

999  Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 72 credits in all enrollments for this course.
Doctoral dissertation research.