CIVIL ENGINEERING  CE
Department of Civil and Environmental Engineering
College of Engineering

221 Statics
Fall, Spring. 3(3-0) 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


273 Civil and Environmental Engineering Measurements
Fall, Spring. 2(1-3) P: (MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently) and (EGR 102 or concurrently)) or (MTH 152H or concurrently) or (LB 118 or concurrently) and (EGR 100 or concurrently) SA: CE 271

Measurements, surveying and error analysis with applications to civil and environmental engineering problems.

274 Graphics for Civil and Environmental Engineers
Fall, Spring. 1(1-3) P: ((MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently) and (EGR 100 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently)) SA: CE 271

Basic operations in CAD software with applications in civil and environmental engineering

280 Principles of Environmental Engineering and Science
Fall, Spring. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental 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)) Physical, chemical and biological processes related to environmental science and engineering. Environmental systems analysis with application to air, water and soil. Analysis of environmental problems and development of engineering solutions.

305 Introduction to Structural Analysis
Fall, Spring. 3(3-0) P: ME 222 and (CE 273 or concurrently) and (CE 274 or concurrently) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering.


312 Soil Mechanics
Fall, Spring. 4(3-3) P: ME 222 and (CE 273 or concurrently) and (CE 274 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.


321 Introduction to Fluid Mechanics
Fall, Spring. 4(3-3) P: (MTH 234 or MTH 254H or LB 220) and CE 221 and (((BE 230 or concurrently) or (CE 273 or concurrently) or (CE 274 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.


337 Civil Engineering Materials
Fall, Spring. 4(3-3) P: (ME 222 or concurrently) and (CE 273 or concurrently) and (CE 274 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, asphalt, concrete, 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 273 or concurrently) or (CE 274 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 Department of Civil and Environmental Engineering. Open to juniors or seniors in the Urban and Regional Planning major. SA: CE 346

Overview of transportation system issues and problems. Fundamentals of highway design and operations. Planning and evaluation of transportation system alternatives.

371 Sustainable Civil and Environmental Engineering Systems
Fall, Spring. 3(3-0) P: ((MTH 234 or concurrently) or (MTH 254H or concurrently) or (LB 220 or concurrently)) and (CE 273 or concurrently) and (CE 274 or concurrently) and (ENE 280 R: Open to juniors and seniors in the Civil Engineering Major or in the Civil and Environmental Engineering Major. General families of materials, materials design processes for civil and environmental engineering problems, structural materials properties, processing methods and environment, microstructure of materials, structural materials selection by utilizing bubble charts.

400 Structural Mechanics
Fall. 3(3-0) P: CE 305 R: Open to juniors or seniors or graduate students in the College of Engineering.


405 Design of Steel Structures
Spring. 3(3-0) P: CE 305 R: Open to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering or in the College of Engineering.

Design of steel beams, columns, tension members and connections. Stability and plastic strength.

406 Design of Concrete Structures
Fall. 3(3-0) P: CE 305 and CE 337 R: Open to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering or in the College of Engineering.

Design of reinforced concrete beams, slabs, columns and footings.

407 Materials Engineering: Properties, Selection and Processing
Fall, Spring. 3(3-0) P: CE 221 and ME 222 RB: MSE 250 R: Open to juniors or seniors in the Chemical Engineering Major or in the Mechanical Engineering Major or in the Civil Engineering Major.

General families of materials, materials design processes for civil and environmental engineering problems, structural materials properties, processing methods and environment, microstructure of materials, structural materials selection by utilizing bubble charts.

418 Geotechnical Engineering
Fall. 3(3-0) 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.

421 Engineering Hydrology
Fall. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: CE 321 and (GLG 201 or GLG 301) R: Open to juniors or seniors or graduate students in the College of Engineering or in the College of Natural Science or in the Department of Plant, Soil and Microbial Sciences.

Hydrologic design of storm water systems. Equilibrium hydrograph analysis, unit hydrographs, infiltration, hydrograph synthesis, and reservoir routing. Groundwater: Darcy’s law, flow nets, well hydraulics, design of capture wells.

422 Applied Hydraulics
Spring. 3(2-2) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: CE 321 or ME 332 R: Open to juniors or seniors or graduate students in the College of Engineering. Fundamentals of open-channel flow. Rapidly and gradually varied nonuniform flow analysis. Confined flows past submerged bodies, in pipe networks, and in turbo machinery. Design applications.
Civil Engineering—CE

431 Pavement Design and Analysis  
Fall. 3(3-0) P: CE 337 R: Open to juniors or seniors or graduate students in the College of Engineering.  
Highway and airfield pavement structural design. Performance measures. Failure mechanisms. Popular design approaches. Use of design codes and design considerations for various rehabilitation alternatives.

432 Pavement Rehabilitation  
Spring. 3(3-0) P: CE 337 RB: CE 431 R: Open to seniors or graduate students in the College of Engineering.  
Engineering concepts and information needed for rehabilitation of pavements. Network and project surveys and evaluation: design of rigid and flexible overlays, other methods of rehabilitation, selection of rehabilitation alternatives. Initial and life cycle cost analysis of various rehabilitation alternatives.

444 Principles of Traffic Engineering  
Fall. 3(3-0) P: CE 341 R: Open 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: (EGR 102 and CE 221) and (MTH 235 or MTH 340 or MTH 347H) 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 364.  
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 (MMP 305 and MMP 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(0-3) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: (CEM 161) or CEM 185H or LB 171L and ENE 280 R: Open to juniors or seniors or graduate students in the College of Engineering.  
Basic chemical and microbiological methods used in the analysis of environmental media. Laboratory methods and 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) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: (CEM 141 and CEM 142) or (CEM 151 and CEM 152) or (CEM 181H and CEM 182H) or (LB 171 and LB 172) and (ENE 280 or BE 230 or GLG 201 or GLG 301 or approval of department).  
Chemistry of natural environmental systems and pollutants. 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 Water and Wastewater Engineering  
Fall. 3(3-1) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: (ENE 280 and BE 230) and (CE 321 or CHE 311) R: Open to juniors or seniors or graduate students in the College of Engineering.  
Engineering and scientific basis and design of physical, chemical and biological methods for the treatment of drinking water and wastewater. Operation process selection and design.

485 Landfill Design  
Spring. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: ENE 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 Environmental Engineering. P: ENE 280  
Fundamentals of microbiology. Application of these concepts to environmental processes such as wastewater treatment, human health and bioremediation.

489 Air Pollution: Science and Engineering  
Spring. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: (CEM 141 and CEM 151 or LB 171) and (MTH 133 or MTH 153H or LB 119) and (ENE 280 or BE 230) and (CE 321 or CHE 311) R: Open to juniors or seniors or graduate students in the College of Engineering.  
Basic physical and chemical principles governing indoor and atmospheric air pollution. Elements of air pollution meteorology, climate change, atmospheric transformations and transport. Air pollution sources and methods for their control. The role of local, state and federal government in air pollution control.

490 Independent Study  
Fall, Spring, Summer. 1 to 3 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, fluid mechanics, geotechnical engineering, hydrology, pavements, structural engineering, or transportation engineering.

495 Senior Design in Civil and Environmental Engineering  
Fall, Spring. 4(2-3) P: (CE 274 and CE 371 and CE 372) and (ENE 421 or ENE 422 or ENE 483 or ENE 489 or CE 418 or CE 431 or CE 405 or CE 406 or CE 444 or CE 449) and (ENE 421 or ENE 422 or ENE 483 or ENE 489 or CE 405 or CE 406 or CE 418 or CE 431 or CE 444 or CE 449) R: Open to seniors or graduate students in the Civil Engineering Major or in the Environmental Engineering Major.  

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 beam and plate structural systems. Methods for iterative solution strategies and use of special computer software.

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

803 Structural Dynamics  
Fall. 1(1-0) CE 302 concurrently.  
084  Advanced Mechanics for Civil Infrastructure
Spring. 3(3-0) RB: (CE 400) or matrix structural analysis R: Open only to graduate students in the College of Engineering.

085  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.

086  Advanced Structural Concrete Design
Spring of even years. 3(3-0) SA: CE 808
Analysis and design of prestressed and conventionally reinforced concrete structures.

087  Seismic Structural Design
Spring of even years. 3(3-0) RB: CE 400 and CE 405 and CE 406

088  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.

089  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

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(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering.

822  Groundwater Modeling
Spring. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering.

829  Mixing and Transport in Surface Waters
Fall of odd years. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: ENE 401

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) R: (CE 337) or equivalent
Structure of materials and structure-property relationships. Principles and theories governing mechanical, physical, and durability characteristics of civil engineering materials. Material selection, production, and quality control.

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 infrastructure applications.

838  Bituminous Materials
Fall of even years. 3(2-3) RB: CE 431 and CE 432 and CE 461
Superpave asphalt mix design, binder tests, hot mix asphalt performance tests, viscoelasticity, continuum damage models, image analysis methods.

841  Traffic Flow Theory
Spring. 3(3-0)
Microscopic and macroscopic traffic flow models, Queueing theory. Gap acceptance. Simulation models for network analysis. Intelligent vehicle highway systems.

844  Highway and Traffic Safety
Fall of odd years. 3(3-0)

847  Traffic Analysis and Control
Spring of even 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.

849  Transportation Research Methods
Spring. 3(3-0)
Application and interpretation of quantitative methods and design of experiments for transportation research. ANOVA, non-parametric, discriminant analysis, factor analysis, multivariate regression, SPSS.

850  Intelligent Transportation Systems (ITS)
Fall of odd years. 3(3-0) RB: Traffic and Transportation Engineering
Technical and policy aspects emerging from the application of advanced technologies to transportation problems. Intelligent Transportation Systems (ITS) user services requirements, available and emerging technologies, case studies of ongoing operational tests, legal institutional and planning issues related to ITS development and deployment.

851  Transportation and the Environment
Spring of even years. 3(3-0) RB: B.S. in Civil Engineering with emphasis on transportation or environmental engineering R: Open only to graduate students in the College of Engineering.

CE—Civil Engineering
Civil Engineering—CE

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 under-
graduate at senior level with a GPA of 3.0 or
higher.
Current research in civil engineering.

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 under-
graduate 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 stu-
dent may earn a maximum of 9 credits in all
enrollments for this course. R: Open to grad-
uate students in the Department of Civil and
Environmental Engineering. Approval of de-
partment.
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 stu-
dent may earn a maximum of 9 credits in all
enrollments for this course.
Selected topics in new or developing areas of civil en-
gineering.

892   Master's Research Project
Fall, Spring, Summer. 1 to 5 credits. A stu-
dent 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.

899   Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits. A stu-
dent 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, scien-
tific 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 stu-
dent may earn a maximum of 9 credits in all
enrollments for this course. R: Open only to
doctoral students in the Civil Engineering ma-
jor.
Research problems of limited scope not pertaining to
thesis accomplished under CE 999.

999   Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A stu-
dent may earn a maximum of 36 credits in all
enrollments for this course.
Doctoral dissertation research.