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

211 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

271 Introduction to Civil and Environmental Engineering
Fall, Spring. 4(3-0) P: (MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently)
Measurement, analysis and design with applications in civil engineering. Surveying and error analysis.

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) and (CE 271 or concurrently)) and (CE 272 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, net present worth, benefit-cost analysis, comparison of economic alternatives, and life-cycle costing.

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 271 or concurrently) and (CE 272 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 271 or concurrently)) and (CE 272 or concurrently) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering.

311 Introduction to Fluid Mechanics
Fall, Spring. 4(3-2) P: (MTH 234 or MTH 254H or LB 220) and CE 221 and (IBE 230 or concurrently) or (CE 271 or concurrently) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering or in the Biosystems Engineering major.

337 Civil Engineering Materials I
Fall, Spring. 4(3-3) P: (ME 222 and 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) or ((CE 271 or concurrently) or (CE 272 or concurrently)) R: Open to juniors or seniors in the Department of Civil and Environmental Engineering or in the Urban and Regional Planning major.
Overview of transportation system issues and problems. Fundamentals of highway design and operations. Planning and evaluation of transportation system alternatives.

342 Pavement Design and Analysis I
Fall. 3(3-0) P: CE 337 R: Open to juniors or seniors or graduate students in the College of Engineering.

343 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 to rehabilitate pavements. Network and project survey 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.

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.

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. Equilibri-um hydrograph analysis, unit hydrographs, infiltrat-ion, 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.

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

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

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.
Traffic engineering.

448 Transportation Planning
Spring. 3(3-0) P: CE 341 Transportation planning process and procedures. Estimation of travel demand using traditional models of trip generation, trip distribution, modal split, and traffic assignment. Use of "quick-response" procedures. Traffic impact of new facilities.
Civil Engineering—CE

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 255H 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 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 (CME 305 and CME 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: 10(0-3) Interdepartmental with 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 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, complexion, 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(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: (ENE 280 or BE 230) and (CE 321 or CHE 311)
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 landfill.

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: ENE 280 and ENE 151 or ENE 152 or ENE 153 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: Open to seniors or graduate students in the College of Engineering. 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) R: Approval of department.

801 Nonlinear Structural Mechanics
Spring of odd years. 3(3-0) RB: 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 composite 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. RB: 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
Spring: 3(3-0) RB: (CE 400) or matrix structural analysis R: Open only to graduate students in the College of Engineering. Advanced linear mechanics. Potential energy principles. Finite element formulations. Applications to problems in structural, geotechnical and pavement engineering.

805 Advanced Design of Steel Structures
Spring: 3(3-0) SA: CE 808 Analysis and design of prestressed and conventionally reinforced concrete structures.

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) RB: 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 Mechanics and design of advanced composite materials and structures and their use for civil infrastructure. Elastic anisotropy and failure theories. Micro- and macro-mechanical analysis of fiber-reinforced polymer composites, particulate composites, and nanocomposites. Analysis and behavior of laminated plates and shells. Design applications to civil and mechanical structures.
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 concurrently.

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

823 Stochastic Groundwater Modeling
Spring of odd years. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering.
P: ENE 821 RB: Groundwater Hydrology, groundwater modeling

829 Mixing and Transport in Surface Waters
Fall of odd years. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Environmental Engineering. P: ENE 801

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. 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
Spring 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.

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.

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.

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. 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 to masters students in the Civil Engineering major. Approval of department.

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.

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.

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