337 Civil Engineering Materials I
Fall, Spring. 4(3-3) P: (ME 222 or concurrently) and (CE 271 or concurrently) R: Open only to juniors or seniors in the Department of Civil and Environmental Engineering.

Common civil engineering construction and paving materials: aggregates, inorganic cements, asphaltics, 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 271 or concurrently) and completion of Tier I writing requirement) RB: STT 351 R: Open to juniors or seniors in the Department of Civil and Environmental Engineering or 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.

400 Structural Mechanics
Fall, Spring. 3(3-0) P: CE 305 R: Open to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering.


405 Design of Steel Structures
Fall, Spring. 4(3-3) P: 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 305 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.

418 Geotechnical Engineering
Fall, Spring. 3(3-0) P: CE 312 R: Open only to juniors or seniors or graduate students in the Department of Civil and Environmental Engineering.


421 Engineering Hydrology
Fall. 3(2-2) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: CE 321 or ME 352 R: Open to seniors or graduate students in the College of Engineering.

Hydrologic design of atmospheric systems. Equilibrium hydrograph analysis, unit hydrographs, infiltration, hydrograph synthesis, and reservoir routing. Groundwater: Darcy’s law, flow nets, well hydraulics, design of capture wells.
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(3-3) 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(0-3) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: CEM 161 or CEM 165H or LB 171. 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 Civil 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). 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 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 concurrently). 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.
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 8038 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 Civil Engineering.  

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

823 Stochastic Groundwater Modeling  
Spring of odd years. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Civil Engineering. P: CE 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 Civil 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.

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

835 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.

836 Advanced Concrete Materials  
Spring of odd years. 3(3-0)  
Microscopic and macroscopic traffic flow models, Queueing theory. Gap acceptance. Simulation models for network analysis. Intelligent vehicle highway systems.

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.

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.

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. P: CE 821 and CE 822  

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 technique, and proper application.

860 Advanced Computational Methods for Engineers  
Fall of even years. 3(3-0) RB: Computer Programming Course  
Advanced computational techniques for engineering applications using Matlab, including robust and fast mechanisms based computational methods, appropriate numerical methods, large data file manipulation and computation, and advanced data visualization techniques.

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.
Civil Engineering—CE

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. R: Open only to master's students in the Civil Engineering major. Approval of department. 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.

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. R: Open only to doctoral students in the Civil Engineering major. 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 student may earn a maximum of 72 credits in all enrollments for this course. Doctoral dissertation research.