CIVIL AND ENVIRONMENTAL ENGINEERING

Office: 2100 E. Engineering Building; 313-577-3789
Chairperson: Shawn P. McElmurry
http://engineering.wayne.edu/cee/

In an increasingly pluralistic society, our urban centers and infrastructure is under a great deal of pressure to provide services that are equitable, affordable, and flow uninterrupted. This condition has brought into sharp focus the profession of civil engineering and the responsibilities of its practitioners. The civil engineer is a leader in such diverse areas of concern as the design of structural systems; water resources planning; the treatment and ultimate processing of solid and liquid wastes; design of building systems which will provide adequate housing for urban dwellers, commerce and industry; the development of transportation systems that serve all; construction methods and management; and the implementation and management of public works infrastructure projects designed to improve the overall urban environment. The responsibilities of the civil engineer directly involve the health, safety and welfare of the public.

The Department of Civil and Environmental Engineering offers graduate degree programs (MSCE, Ph.D.) in which students may specialize in the following areas: structures, environmental engineering, transportation, and in cooperation with the Engineering Technology Division, construction management.

DITTRICH, TIMOTHY: Ph.D., University of Colorado - Boulder; M.S. Cornell University; B.S., University of Wisconsin - Madison. ; Assistant Professor

EAMON, CHRISTOPHER D.: Ph.D., M.Arch., M.S., University of Michigan; B.S., University of Wisconsin; Professor

HUANG, YAOXIAN: Ph.D., Michigan Technological University; M.S., B.S., East China University of Science and Technology; Assistant Professor

KOO, HYUN JEONG: Ph.D., University of Texas at Austin; M.S., University of Illinois at Urbana-Champaign; M.S., Yonsei University; B.S., Hanyang University; Assistant Professor

LAVRENZ, STEVEN: Ph.D., Purdue University; M.S., B.S., Iowa State University; Assistant Professor

MAGLOGIANNI, MYRSINI: Ph.D., The University of Texas at Arlington; M.S., B.S., Democritus University of Thrace, Greece; Assistant Professor

MCELMURRY, SHAWN: Ph.D., M.S., Michigan State University; B.S., Central Michigan University; Professor

MENKULASI, FATMIR: Ph.D., Virginia Tech; Assistant Professor

MILLER, CAROL J.: Ph.D., M.S., B.S., University of Michigan; Professor

QIAN, XIAODONG: Ph.D., University of California-Davis; B.S., Tsinghua University ; Assistant Professor

SHUSTER, WILLIAM: Ph.D., The Ohio State University; B.S., University of Michigan; Professor and Chair

WAGER, YONGLI: Ph.D., University of Virginia; M.S., Guangxi University; B.S., Sichuan University; Associate Professor

ZHOU, QINGWEN: Ph.D., M.S., University of Illinois Urbana-Champaign; B.S., Tongji University, Chin; Instructor

- Civil Engineering (M.S.) (http://bulletins.wayne.edu/graduate/college-engineering/civil-environmental-engineering/civil-engineering-ms/)
- Environmental and Sustainability Engineering (M.S.) (http://bulletins.wayne.edu/graduate/college-engineering/civil-environmental-engineering/environmental-sustainability-engineering-ms/)
- Civil Engineering (Ph.D.) (http://bulletins.wayne.edu/graduate/college-engineering/civil-environmental-engineering/civil-engineering-phd/)
- Civil Engineering and Urban Sustainability (Ph.D. Dual-Title) (http://bulletins.wayne.edu/graduate/college-engineering/civil-environmental-engineering/civil-engineering-urban-sustainability/)

CE 5220 Environmental Chemistry Cr. 3
Fundamentals of aqueous chemistry for environmental engineers and scientists. Basic chemistry, equilibria, kinetics and thermodynamics; includes acid/base reactions, precipitation/dissolution, oxidation/reduction reactions and partitioning. Offered Every Other Year.
Fees: $5

CE 5230 Water Supply and Wastewater Engineering Cr. 3
Analysis and design of water supply and wastewater treatment systems; water distribution systems; treatment of municipal water supplies, including sedimentation, softening, filtration and disinfection; design of sanitary and storm sewers; primary, secondary and tertiary treatment plant design; sludge handling. Offered Yearly.
Prerequisite: CE 4210 with a minimum grade of C-
Fees: $5

CE 5240 Air Pollution Engineering Cr. 3
Designed to introduce students to the fields of air pollution and air quality, this course will provide an overview of the U.S. regulation of air pollution and explain the fundamental principles of the physical and chemical processes of air pollutants associated with natural and anthropogenic emission sources. In particular, we will focus on air pollutants that contribute to the formation of acid rain, smog and haze, as well as the gas- and particle-phase tropospheric chemistry. Engineering methods to control and mitigate air pollution will be also covered. Offered Yearly.

CE 5350 Introduction to Structural Dynamics Cr. 4
Dynamic properties of structures,. Modeling of dynamic loads. Structural response to dynamic loading. Structural design requirements for dynamic loads. Fundamental techniques of dynamic system analysis. Offered Winter.
Prerequisite: ME 3400 with a minimum grade of C- and CE 4400 with a minimum grade of C-

CE 5370 Finite Element Analysis Fundamentals Cr. 3
Matrix structural analysis, discretization of continuous structural systems, stress analysis. Commercial finite element software preprocessing for developing finite element models; post-processing for evaluating analysis results. Offered Fall.
Prerequisites: CE 4400 with a minimum grade of C-

CE 5390 Design of Prestressed Concrete Structures Cr. 3
Focuses on the design of prestressed structures. The principle and methods of prestressing are discussed including approaches for computing prestress losses. The course deals with the estimation of capacity of various structural members such as beams and columns and their response to various structural actions such as flexure, vertical shear, horizontal shear, and combined axial and flexure loads. Performance at service is discussed in terms of stresses, deflections and crack control. Offered Yearly.
Prerequisite: CE 4420 with a minimum grade of C-

CE 5410 Energy, Emissions, Environment (E3) Design Cr. 3
Provides students the tools to uncover the relation between energy consumption and energy generation and optimize processes to take most advantage of low emitting energy options. Exposes students to design tools and methodologies from a diverse group of sources including US EPA, DOE, EIA, and the latest in emerging research. Offered Fall.
Equivalent: AET 5410, STE 5410

CE 5510 Geotechnical Engineering I Cr. 4
Site investigation, site improvement, bearing capacity and settlement of shallow foundations, axial capacity and lateral deflection of deep foundations, design of conventional earth retaining walls, and basics of slope stability analyses. Offered Fall.
Prerequisites: CE 4510 with a minimum grade of C-

CE 5520 Geotechnical Engineering II Cr. 3
Lateral earth pressure theories, design of conventional earth-retaining walls and of reinforced earth walls, anchored sheet-pile walls and cofferdams, fundamentals of soft-ground tunneling, two- and three-dimensional slope stability analyses, and static design of earth dams. Offered Every Other Year.
Prerequisites: CE 4510 with a minimum grade of C-

CE 5610 Advanced Highway Design Cr. 3
This course covers the standards recommended by: American Association of State Highway and Transportation Officials (AASHTO); FHWA; and MDOT for designing and evaluation of highways. Its objective is to introduce the students to the concepts, requirements, and fundamental skills for highway design and evaluation. The primary goal of geometric design is to provide for the safety and comfort of road users with due regard to social, economic and environmental constraints. Although there are suggested design standards and controls that must be followed to meet design goals, their application is determined on a case-by-case basis. The objective of this course is to illustrate the practical application of scientific knowledge to the planning and designing of roadway elements. The course uses up-to-date software design tools in accomplishing these goals. Upon completion of the course, the student is expected to be able to design and evaluate highways per AASHTO, MDOT and FHWA standards. Offered Fall.
Prerequisites: CE 4640 with a minimum grade of C-

CE 5620 Intelligent Transportation Systems Cr. 3
This course aims to provide graduate students with a comprehensive understanding of Intelligent Transportation Systems (ITS) and their role in enhancing transportation efficiency, safety, and sustainability. Students will explore the principles, technologies, and applications of ITS, including data-driven decision making, vehicle-to-everything (V2X) communication, autonomous and connected vehicles, real-time traffic management, and multimodal transportation integration. In addition, emerging AI technologies and their applications are also covered. Through a combination of theoretical foundations and practical case studies, students will develop skills in designing, analyzing, and implementing ITS solutions to address contemporary challenges in urban mobility, traffic congestion, environmental impacts, and infrastructure resilience. Offered Winter.

CE 5640 Advanced Transportation Systems Design and Operation Cr. 3
Provides an overview of various system components of transportation, including the driver, vehicle and roadway. The subject matter will be covered at an intermediate level, appropriate for CEE students already familiar with the basic concepts of transportation engineering who wish to expand their knowledge, and for non-CEE students specifically interested in applications of transportation engineering theory. There will be a particular emphasis on transportation safety and multimodal roadway operations, as are typical priorities in an urban or suburban setting. Traffic flow design elements including volume, density and speed; intersection design elements including delay, capacity and crash countermeasures and terminal design elements including inflow, outflow and circulation. Offered Fall.

CE 5830 Business of Engineering Cr. 3
Defining the engineering company, creating the organization, support services, business development, project management, scheduling, budgeting and profitability, operations, financial management and risk management. Offered Every Term.
Prerequisites: CE 4850 with a minimum grade of C-

CE 5995 Special Topics in Civil Engineering I Cr. 1-3
Topics to be announced in Schedule of Classes. Offered Intermittently.
Repeatable for 12 Credits

CE 6010 Advanced Construction Engineering and Management Cr. 3
This course will cover the life cycle of a construction project including planning, design, procurement, construction, commissioning, and close-out phases. Also, the students will learn about fundamentals of cost estimating, scheduling, quality, safety and risk management, sustainability, and various applicable technology for construction projects. Offered Winter.

CE 6050 Construction Cost Estimating Cr. 3
Estimating construction costs of engineering projects including materials, man-hours, equipment and overhead. Emphasis on construction equipment, including productivity and planning. Bidding and bid documents. Offered Every Other Year.
Prerequisites: CE 4850 with a minimum grade of C-

CE 6060 Construction Techniques and Methods Cr. 3
Construction techniques and methods for excavation, foundations, concrete, wood, steel, masonry, heavy construction, wastewater treatment plants, highways and roads, high rise structures, bridges, and tunneling projects. Offered Every Other Year.
Prerequisites: CE 3450 with a minimum grade of C-

CE 6130 Open Channel Hydraulics Cr. 3
Theoretical development of equations governing flow in open channels. Application to real-world engineering problems involving water surface profiles, flood studies, and river. Offered Winter.
Prerequisites: CE 3250 with a minimum grade of C-

CE 6150 Hydrologic Analysis and Design Cr. 3
Principles of surface water hydrology and their application for evaluation of floods and the design of surface runoff control system; watershed characteristics; design storms and SCS methods; unit hydrographs; hydrologic models; application of computer methods. Offered Every Other Year.
Prerequisites: CE 4210 with a minimum grade of C-

CE 6160 Principles of Atmospheric Chemistry and Applications Cr. 3
Provides the student with an overview of photochemical reactions that directly impact atmospheric composition and thus pertinent to the management of air quality. Focuses on atmospheric radicals, tropospheric ozone and mechanisms of particulate matter formation; the impact of these constituents associated with air pollutions on air quality and global climate change. Students will be introduced to modeling atmospheric chemistry using simple box models as well as state-of-the-science 3-dimensional global chemical transport models. Offered Yearly.

CE 6170 River Assessment and Restoration I Cr. 3
Students will learn field methods to assess stability, condition of rivers and contributing watersheds. Students will learn basic surveying techniques, apply these to the collection, analysis of cross-sectional data and longitudinal profiles. Other field methods include: Wolman pebble count, measurement of plan-form geometry, identification of key geomorphic features (e.g., bankful elevation, abandoned floodplains, mid-channel and transverse features). Field measurements will be made to calculate Bank Erosion Hazard Index (BEHI), Near-Bank Stress Index. Students will learn how to monitor a river for bank erosion (e.g., bank pins), riverbed aggradation/degradation (e.g., scour chains). Students will learn stream classification, sediment budgeting, methods to quantify sediment yield and transport, and how to analyze data, and identify trends in river hyrdology and sediment supply. Offered Every Other Spr/Sum.
Equivalent: ESG 6150

CE 6190 Groundwater Cr. 3
Historical background, aquifers and aquitards, saturated and unsaturated flow, sources of ground water contamination, artificial recharge of ground water, development of ground water basins and efficient use of ground water resources. Offered Yearly.
Prerequisites: CE 3250 with a minimum grade of C-

CE 6270 Sustainability Assessment and Management Cr. 3
Sustainability assessment and management for engineering design and development; theoretical, regulatory, and practical implications; Detroit and global applications. Offered Yearly.
Equivalent: STE 6270

CE 6330 Advanced Structural Analysis Cr. 3
Effect of axial loads on stiffness of flexural members. Buckling of trusses and rigid frames. Matrix method of analysis. Complex structures. Computer applications. Offered Fall.
Prerequisites: CE 4410 with a minimum grade of C-

CE 6340 Bridge Design and Evaluation Cr. 3
Concepts, procedures, methods of design and condition evaluation for modern highway bridges, according to current specifications. Entire system is covered, including superstructure, substructure, and their connections. Offered Every Other Year.
Prerequisites: CE 4420 with a minimum grade of C-

CE 6370 Advanced Reinforced Concrete Design Cr. 3
Theory and design of two-way slabs, footings, retaining walls, shear walls, and composite beams using ultimate strength design. Precast and prestressed concrete fundamentals. Offered Yearly.
Prerequisites: CE 4420 with a minimum grade of C-

CE 6410 Advanced Steel Design Cr. 3
Advanced topics of structural steel design: thin walled rolled and built-up members, beam columns, lateral torsional buckling, steel fatigue design, connection details. Steel design project. Offered Every Other Year.
Prerequisites: CE 4420 with a minimum grade of C-

CE 6580 Geoenvironmental Engineering I Cr. 4
Properties and test methods for natural and synthetic materials used in landfills; analysis of chemical interactions, flow mechanisms, stability and settlement for the design of landfill components. Offered Yearly.
Prerequisites: CE 4510 with a minimum grade of C-

CE 6660 Pavement Asset Management Cr. 3
Principles and practices of pavement management at the network and project level: serviceability, pavement design models, economic analysis, and priority programming. Offered Yearly.
Prerequisites: CE 4610 with a minimum grade of C- or CE 4640 with a minimum grade of C-

CE 6880 Building Information Modeling (BIM) Cr. 3
Lectures, hands-on demonstrations and lab exercises to familiarize students with concepts and tools in Revit Architecture 2010 software; how software integrates 3D and 2D modeling.Includes an overview of the Building Information Modeling (BIM) process; integration of designs from different disciplines (architectural, structural and MEP) in a BIM model; and use of BIM tools (including Revit and Navisworks) to create 2D, 3D, 4D (schedule) and 5D (cost) models for project control purposes, as well as clash detections. Offered Every Other Year.

CE 6910 Pharmaceutical Waste: Environmental Impact and Management Cr. 2-3
Course designed for advanced professional and graduate students with sufficient chemistry and/or biological sciences background who are interested in the environmental impact, management, and regulation of waste pharmaceuticals as emerging issues. Offered Winter.
Restriction(s): Enrollment is limited to Graduate or Professional level students.
Equivalent: PSC 6910

CE 6991 Internship in Industry Cr. 1-4
Written report describing internship experience. Offered Every Term.
Repeatable for 4 Credits

CE 7020 Construction Safety Cr. 3
Safety problems in the construction industry and their technical and managerial solutions, construction accident and failure analysis and control. Safety program design and implementation with TQM integration. Offered Yearly.
Prerequisite: CE 6010 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7070 Risk and Reliability in Civil Engineering Cr. 3
Uncertainty in civil engineering practice (e.g., loads, traffic, water demand, construction quality). Reliability theory based on probabilistic and statistical methods. Reliability-based engineering design and decision making. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7080 Civil Engineering Research Methods Cr. 3
Methods of data collecting and statistical analysis in context of civil engineering. Applications of advanced statistical analysis techniques, theory, discussion of methodological limitations. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

CE 7090 Statistical and Econometric Methods in Civil Engineering II Cr. 3
The purpose of this course is to provide students with advanced training in the application of various statistical/econometric analysis techniques for addressing civil engineering-related problems. The methods considered in this class are an extension of the techniques taught in CE 7080. The course will present a number of model-estimation methods that are used in the areas of planning, design, operations and management of transportation systems. The course will emphasize model estimation and application, but underlying theory and limitations will be discussed to ensure that the methods are properly applied and understood. After completing this course, students will have exposure to an assortment of statistical modeling tools and additional insight to transportation data sources, their limitations, and the analysis of such data. It is important to note that the methods presented go well beyond the techniques typically covered in statistics courses. Offered Intermittently.
Prerequisite: CE 7080 with a minimum grade of B-
Restriction(s): Enrollment is limited to Graduate level students.

CE 7160 Advanced Principles of Atmospheric Chemistry and Applications Cr. 3
This course will provide students with an overview of photochemical reactions that directly impact atmospheric composition and thus pertinent to the management of air quality. In particular, we will focus on atmospheric radicals, tropospheric ozone and mechanisms of particulate matter formation; the impact of these constituents associated with air pollutions on air quality and global climate change. Students will be introduced to modelling atmospheric chemistry using simple box models as well as state-of-the-science 3-dimensional global chemical transport models. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7170 Advanced River Assessment and Restoration I Cr. 3
Students will learn field engineering methods to assess the stability and condition of rivers and contributing watersheds. Students will learn basic surveying techniques, apply them to the collection and analyze cross-sectional and longitudinal profile data. Other methods include: Wolman pebble count, measurement of plan-form geometry, identification of key geomorphic features. Field measurements will be made to calculate the Bank Erosion Hazard Index (BEHI) and Near-Bank Stress Index among other parameters. Students will learn how to monitor riverbank erosion and riverbed aggradation/degradation via scour chains. Students will learn stream classification, the importance of sediment budget, methods to quantify sediment yield and transport, and how to analyze data to assess trends in hyrdology and sediment supply. Offered Every Other Spr/Sum.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7180 Advanced River Assessment & Restoration II - Field Methods in Fluvial Geomorphology Cr. 3
Students will learn advanced field methods to assess the stability & condition of a river. Rivers are composed of water & sediment, both flowing under the influence of gravity. The proportions of water & sediment that make up the stream will dictate the stable form or the extent to which it is unstable. As such, one must be able to accurately quantify the water & sediment delivered to and transported through a stream. A considerable portion of this class will be spent in the field where students will learn techniques for measuring stream-flow & sediment transport. Students will learn several methods for calculating sediment transport & sediment yield rates. Students will learn field methods to quantitatively characterize the bed of a stream & the movement of that bed. Additionally, the quantification of sediment sinks such as deposition on the floodplain & in ponds/reservoirs, will be performed. Students will learn how the hydrology & sediment supplies to the Great Lakes have changed. Offered Every Other Spr/Sum.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7190 Groundwater Modeling Cr. 3
Analytical and numerical models of groundwater hydraulics and contaminant transport. Application of theoretical material developed in C E 6190. Case studies of model applications to real field problems. Offered Yearly.
Prerequisite: CE 6190 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7240 Advanced Air Pollution Engineering Cr. 3
Designed to introduce students to the fields of air pollution and air quality, this course will provide an overview of the U.S. regulation of air pollution and explain the fundamental principles of the physical and chemical processes of air pollutants associated with the natural and anthropogenic emission sources. In particular, we will focus on air pollutants that contribute to the formation of acid rain, smog and haze, as well as the gas- and particle-phase tropospheric chemistry. Engineering methods to control and mitigate air pollution will be also covered. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7270 Big Data Applications in Environmental Engineering Cr. 3
This graduate-level course will focus on numerical methods and computational techniques required to run state-of-the-art 3-dimensional (3D) chemical transport models and process big data in order to address problems in environmental engineering, with a focus on air pollution and air quality. Students will have hands-on experience running GEOS-Chem models over Grid High Performance Computing at Wayne State University and employing programming skills to analyze the often dense model output datasets, and then employing strategies to visualize and interpret these data. Offered Intermittently.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7280 Applied Environmental Microbiology Cr. 3
Provides knowledge of microbiology, roles and relations of microorganisms to the environment. Topics include practical applications of environmental microbiology to environmental issues including water treatment, biodegradation and bioremediation of environmental pollutants, production of alternative fuels, and emerging environmental concern. Special consideration will be given to water treatment and microbe-mediated cycling of organic materials (i.e. pollutants) in a variety of natural and engineered environment. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

CE 7300 Advanced Structural Mechanics Cr. 3
Theory of bending and torsion of bars, beams on elastic foundations. Introduction to theory of thin plates. Linear elastic fracture mechanics, application to brittle solids. Offered Fall.
Prerequisite: CE 6330 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7311 Sustainability of Urban Environmental Systems Cr. 2
Students will be introduced to topics in urban sustainability from multiple disciplinary perspectives such as: ecology, anthropology, communication, engineering, economics and urban planning. Questions in fostering a more sustainable urbanism will be introduced and evaluated. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: BIO 7310

CE 7370 Advanced Finite Element Analysis Cr. 3
Advanced topics in finite element analysis; stability analysis and vibrations of structural systems; modeling of complex structures, dynamic analysis, and nonlinear structural problems; and computer applications. Offered Every Other Year.
Prerequisite: CE 5370 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7380 Advanced Topics in Steel Design Cr. 3
Focuses on steel plasticity, plastic mechanism analysis, and the application of these concepts to design for strength and stability of steel structures. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7385 Advanced Topics in Reinforced Concrete Design Cr. 3
Focuses on reinforced concrete plasticity, plastic mechanism analysis, and the application of these concepts to design for strength of reinforced concrete structures. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7395 Advanced Design of Prestressed Concrete Structures Cr. 3
Focuses on the design of prestressed structures. The principle and methods of prestressing are discussed including approaches for computing prestress losses. Deals with the estimation of capacity of various structural members such as beams and columns and their response to various structural actions such as flexure, vertical shear, horizontal shear, and combined axial and flexure loads. Performance at service is discussed in terms of stresses, deflections and crack control. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7460 Advanced Composite Materials for Civil Infrastructure Cr. 3
Infrastructure problems. Advanced fiber reinforced plastics, including applications in primary/secondary and marine structures, and in rehabilitation. High performance fiber reinforced concrete. Controlled composite properties via composite design. Review of composite analysis and failure criteria based on micromechanics and laminate theory. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7580 Environmental Remediation Cr. 3
Site assessment; soil and groundwater investigation for remediation; application of remediation technologies; legislation related to remediation. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7600 Highway Safety and Risk Management Cr. 3
The focus of this course is on developing knowledge, skills, and abilities for planning, managing, and operating safe roadways for all users and modes of travel. It includes analysis of roadway design alternatives, statistical analysis of roadway safety issues, and crash countermeasure selection and evaluation. Students should have prior knowledge of the roadway geometric design process, traffic flow fundamentals (i.e., volume, density, speed, etc.), traffic control devices, and basic statistics (linear regression, t-tests, p-values, etc.). Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7620 Traffic Engineering Control and Operation Cr. 3
Traffic flow theories, macroscopic and microscopic models of traffic control, statistical analysis; design and application of intelligent transportation systems on traffic flow characteristics; evaluation. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7630 Urban Transportation Planning Cr. 3
This course provides an in-depth view of transportation planning and the analytical and statistical tools needed to understand different planning principles and the relationship between transportation and land use, travel demand forecasting, demand versus supply characteristics, and the development and evaluation of alternative systems. Additional topics will include benefit-cost analysis, transportation equity analysis, and transit accessibility measurement. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7670 Advanced Traffic Signal Systems Cr. 3
Analysis and design of traffic signal systems. Hardware, communication and detection systems associated with microcomputer-based signal systems. Coordinated signal systems. Offered Every Other Year.
Prerequisite: CE 7620 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7810 Advanced Legal Aspects of Engineering and Construction Cr. 3
Examines the legal structure of the architecture, engineering, and construction (AEC) industry from the perspective of the working professional. Topics covered include: fundamental principles of law; components of a contract; industry standard agreements; project delivery methods; liabilities of owner, architect, engineer, contractor, and subcontractors/suppliers; torts, negligence, and claims; delays and unforeseen conditions; insurance and indemnification; intellectual property; liens and bonds; dispute resolution basics; rights in land, boundaries, and foundations. Case studies will be used, where appropriate, to illustrate keys concepts. Offered Intermittently.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7830 Construction Planning and Scheduling Cr. 3
Planning and scheduling of construction projects, project networks and critical path methods, resource leveling, use of Primavera software. Offered Yearly.
Prerequisite: CE 6010 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7840 Facilities Management Cr. 3
Buildings and grounds operations and maintenance, planning design and construction, facilities economics and financing, real estate administration, environmental health and safety, health issues. Offered Winter.
Prerequisite: CE 6010 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7860 Construction Accounting and Financial Management Cr. 3
Construction financial management, construction accounting systems, analysis of financial statements, monitoring and controlling construction costs, managing overhead costs, markup, profit center analysis, cash flows for construction projects, financing, making financial decisions. Offered Every Other Year.
Prerequisite: CE 6010 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7890 Integrated Construction Project Management Cr. 3
Construction project management framework, construction project integration, project scope management, time management, cost management, quality management, procurement management, risk management, communication management. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7990 Directed Study Cr. 1-4
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 6 Credits

CE 7995 Special Topics in Civil Engineering II Cr. 1-3
A consideration of special subject matter in civil engineering. Topics to be announced in Schedule of Classes. Offered Intermittently.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 12 Credits

CE 7996 Research Cr. 1-4
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 6 Credits

CE 8999 Master's Thesis Research and Direction Cr. 1-8
Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Candidate Masters; enrollment is limited to Graduate level students.
Repeatable for 8 Credits

CE 9990 Pre-Doctoral Candidacy Research Cr. 1-8
Research in preparation for doctoral dissertation. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 12 Credits

CE 9991 Doctoral Candidate Status I: Dissertation Research and Direction Cr. 3-9
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 9 Credits

CE 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 1-18
Offered Every Term.
Prerequisite: CE 9991 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 18 Credits

CE 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CE 9992 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

CE 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: CE 9993 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

CE 9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction Cr. 0
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Fees: $434.8
Repeatable for 0 Credits