

# CIVIL ENGINEERING (CIVE)

## Civil Engineering Graduate Courses

### **CIVE 819 FLOW SYSTEMS DESIGN (3 credits)**

Application of hydraulic principles to the design of water distribution systems, wastewater and stormwater collection systems, channelized flow systems and treatment facilities. (Cross-listed with CIVE 419).

**Prerequisite(s):** CIVE 326 or CIVE 327; Corequisite: CIVE 352

### **CIVE 822 POLLUTION PREVENTION: PRINCIPLES AND PRACTICES (3 credits)**

Introduction to pollution prevention (P2) and waste minimization methods. Practical applications to small businesses and industries. Legislative and historical development of P2 systems analysis, waste estimation, P2 methods, P2 economics, and sources of P2 information. (Cross-listed with CIVE 422).

### **CIVE 823 PHYSICAL & CHEMICAL TREATMENT PROCESSES IN ENVIRONMENTAL ENG (3 credits)**

Evaluation and analysis of physical and chemical unit operations and processes applied to the treatment of water, wastewater, and hazardous wastes.

**Prerequisite(s):** CIVE326 and CIVE425

### **CIVE 824 SOLID WASTE MANAGEMENT ENGINEERING (3 credits)**

Planning design and operation of solid and waste collection processing, treatment, and disposal systems including materials, resources and energy recovery systems. (Cross-listed with CIVE 424).

**Prerequisite(s):** CIVE 326 and CIVE 334

### **CIVE 826 DESIGN OF WATER TREATMENT FACILITIES (3 credits)**

Analyses of water supplies and design of water treatment and distribution systems. (Cross-listed with CIVE 426).

**Prerequisite(s):** CIVE 420

### **CIVE 827 DESIGN OF WASTEWATER TREATMENT AND DISPOSAL FACILITIES (3 credits)**

Analysis of systems for wastewater treatment and disposal. (Cross-listed with CIVE 427).

**Prerequisite(s):** CIVE 420

### **CIVE 828 ENVIRONMENTAL ENGINEERING CHEMISTRY (3 credits)**

Basic concepts from general chemistry. Thermodynamic and kinetic basis for the composition of aquatic systems. Equilibrium chemistry, including acid-base reactions, reduction-oxidation reactions, metal speciation and precipitation, and gas/liquid partitioning.

**Prerequisite(s):** CIVE 326. Not open to non-degree graduate students.

### **CIVE 829 BIOLOGICAL WASTE TREATMENT (3 credits)**

Principles of biological processes and their application in the design of waste treatment systems.

**Prerequisite(s):** CIVE 326 or equivalent.

### **CIVE 830 FUNDAMENTALS OF WATER QUALITY MODELING (3 credits)**

Comprehensive study of water quality and the effects of various water pollutants on the aquatic environment; modeling of water quality variables. (Cross-listed with CIVE 430).

**Prerequisite(s):** CIVE 326

### **CIVE 834 SOIL MECHANICS II (3 credits)**

(Lecture 3, option Lab 3) Application of the effective stress principle to shear strength of cohesive soils; analysis of stability of slopes. Development of continuum relationships for soils; solutions for stresses and displacements for an elastic continuum, solution of the consolidation equation for various initial and boundary conditions.

**Prerequisite(s):** CIVE334

### **CIVE 836 FOUNDATION ENGINEER (3 credits)**

(Lecture 3, Optional Lab 3) Subsoil exploration and interpretation; selection of foundation systems; determination of allowable bearing capacity and settlement; design of deep foundations; pile driving analysis; control of groundwater.

**Prerequisite(s):** CIVE 334

### **CIVE 839 INTRODUCTION TO BRIDGE ENGINEERING (3 credits)**

Structural types, bridge loads, design of bridge slabs, steel girder bridges, and prestressed concrete girder bridges. Evaluation of existing bridges. Problems related to fatigue and corrosion. Field testing of bridges.

**Prerequisite(s):** CIVE440 or CIVE441 or CIVE840

### **CIVE 840 REINFORCED CONCRETE DESIGN I (3 credits)**

Introduction to the design of reinforced concrete building components. Emphasis is placed on the design of flexural and compression members, simple walls, foundations, and floor systems using the latest ACI design requirements.

**Prerequisite(s):** CIVE341

### **CIVE 842 STRUCTURAL DYNAMICS (3 credits)**

Dynamic behavior of civil engineering structures. Free and forced vibrations of multi degree-of-freedom systems. Response of continuous beam and frames. Elasto-plastic behavior. Dynamic loads on bridges. Analysis and design considerations for buildings and bridges subjected to seismic loadings. Emphasis is on application of computer-aided numerical procedures.

**Prerequisite(s):** CIVE 443

### **CIVE 843 ADVANCED STRUCTURAL ANALYSIS (3 credits)**

Matrix analysis methods and computer solutions for indeterminate structures. Additional topics: static condensation, shear deformations, and non-prismatic members in matrix-based analyses, moment distribution method, load cases and load combinations for buildings and bridges, and influence lines and analysis for moving loads. (Cross-listed with CIVE 443)

**Prerequisite(s):** CIVE 341. Not open to non-degree graduate students.

### **CIVE 844 STRUCTURAL DESIGN AND PLANNING (3 credits)**

Principles of design of steel and reinforced concrete structural building systems, planning of building vertical and horizontal load resisting systems, and bridge systems. Several design projects involve indeterminate analysis and design concepts for both steel and reinforced concrete. (Cross-listed with CIVE 444).

**Prerequisite(s):** CIVE 440 and CIVE 441

### **CIVE 846 STEEL DESIGN II (3 credits)**

A continuation of CIVE 441. The principles and procedures used in design of steel buildings, design of plate girders, design and analysis of building systems, design and analysis of composite steel-concrete building systems, innovative building systems, and introduction to seismic design of steel buildings. Plate buckling, beam, column, and beam-column design. Frame stability. Introduction to connection design.

**Prerequisite(s):** CIVE441

### **CIVE 847 REINFORCED CONCRETE II (3 credits)**

Shear friction theory, strut-and-tie modeling, anchorage, deflection, slender and bi-axially loaded members, torsion, two-way action and punching shear, and footing design. Excel spreadsheets are developed and used for various design tasks. (Continuation of topics covered in CIVE 440/CIVE 840.) (Cross-listed with CIVE 447).

**Prerequisite(s):** CIVE 440 or CIVE 840

### **CIVE 849 INTRODUCTORY FINITE ELEMENT ANALYSIS IN SOLID MECHANICS (3 credits)**

Matrix methods of analysis. The finite element stiffness method with a focus on solid mechanics. Isoparametric elements formulation based on energy principles. Perform finite element analyses using commercial software.

**Prerequisite(s):** CIVE 443 or 843

**CIVE 850 PRESTRESSED CONCRETE (3 credits)**

Analysis and design of prestressed concrete members. Axial force, bending, shear, torsion, prestress losses, initial and long-term deflection, partial prestressing, statically indeterminate structures.

**Prerequisite(s):** CIVE341 and CIVE440

**CIVE 851 INTRODUCTION TO FINITE ELEMENT ANALYSIS (3 credits)**

Matrix methods of analysis. The finite element stiffness method. Computer programs. Applications to structures and soils. Introduction to finite element analysis of fluid flow. (Cross-listed with CIVE 451).

**Prerequisite(s):** MENG 3250 or EMEC 3250; and MENG 4800 or EMEC 4800.

**CIVE 852 WATER RESOURCES DEVELOPMENT (3 credits)**

Theory and application of systems engineering with emphasis on optimization and simulation techniques for evaluating alternatives in water resources developments related to water supply, flood control, hydroelectric power, drainage, water quality, water distribution, irrigation and water measurement. (Cross-listed with CIVE 452).

**Prerequisite(s):** CIVE 352

**CIVE 853 GIS IN WATER RESOURCES (3 credits)**

Familiarization with a wide range of spatial information and used in hydrologic and water resources analysis. Development of expertise in GIS systems, especially ArcGIS, Digital mapping and analysis of water resources information. Hydrologic terrain analysis using digital elevation models. Integration of time series and geospatial data. Hydrologic Information Systems. River and watershed networks. Evapotranspiration, Precipitation (PRISM), Soil, and Landuse maps, and databases. Use of Remote Sensing tools.

**CIVE 854 HYDRAULIC ENGINEERING (3 credits)**

Fundamentals of hydraulics with applications of mechanics of solids, mechanics of fluids, and engineering economics to the design of hydraulic structures. Continuity, momentum, and energy principles are applied to special problems from various branches of hydraulic engineering. (Cross-listed with CIVE 454).

**Prerequisite(s):** CIVE 352

**CIVE 855 NONPOINT SOURCE POLLUTION CONTROL ENGINEERING (3 credits)**

Identification, characterization, and assessment of nonpoint source pollutants; transport mechanisms and remediation technologies; design methodologies and case studies. (Cross-listed with CIVE 455).

**Prerequisite(s):** CIVE 326 and CIVE 352

**CIVE 856 SURFACE WATER HYDROLOGY (3 credits)**

Stochastic analysis of hydrological data and processes including rainfall, runoff, infiltration, temperature, solar radiation, wind, and non-point pollution. Space-time hydrologic modeling with emphasis on the application of techniques in the design of engineering projects. (Cross-listed with CIVE 456).

**CIVE 857 APPLIED STRUCTURAL ANALYSIS (3 credits)**

Review of basic concepts. Mesh generation using a preprocessor. 2D and 3D Model generation. Boundary conditions. Implicit and explicit solution algorithms. Interpretation of analysis results using a post-processor. Solution of problems using existing FE software.

**Prerequisite(s):** CIVE851

**CIVE 858 GROUNDWATER ENGINEERING (3 credits)**

Application of engineering principles to the movement of groundwater. Analysis and design of wells, well fields, and artificial recharge. Analysis of pollutant movement. (Cross-listed with CIVE 458).

**Prerequisite(s):** CIVE 352.

**CIVE 859 RELIABILITY OF STRUCTURES (3 credits)**

Fundamental concepts related to structural reliability, safety measures, load models, resistance models, system reliability, optimum safety levels, and optimization of design codes.

**Prerequisite(s):** CIVE341, not open to nondegree students

**CIVE 861 URBAN TRANSPORTATION PLANNING (3 credits)**

Development of urban transportation planning objectives and goals. Data collection procedures, land use and travel forecasting techniques, trip generation, trip distribution, modal choice analysis, and traffic assignment. Site development and traffic impact analysis. (Cross-listed with CIVE 461).

**Prerequisite(s):** CIVE 361

**CIVE 862 HIGHWAY DESIGN (3 credits)**

Design of roadways, intersections, interchanges, parking facilities, and land development site access and circulation. Emphasis on design projects. (Cross-listed with CIVE462)

**CIVE 863 TRAFFIC ENGINEERING (3 credits)**

Design of signalized intersections, arterial street and network signal systems, and freeway control systems. Emphasis on design projects. (Cross-listed with CIVE463)

**Prerequisite(s):** CIVE361

**CIVE 864 ANALYSIS AND ESTIMATION OF TRANSPORTATION DEMAND (3 credits)**

Introduction to conceptual, methodological and mathematical foundations of analysis and design of transportation services; review of probabilistic modeling; application of discrete choice models to demand analysis.

**Prerequisite(s):** CIVE461 or CIVE861 or equivalent

**CIVE 865 HIGHWAY GEOMETRICS (3 credits)**

Principles of highway geometrics. Sight distances, design vehicles, vehicle characteristics, horizontal and vertical alignment, cross section elements, and at-grade intersections and interchanges.

**Prerequisite(s):** (CIVE462 or CIVE862), not open to nondegree students

**CIVE 866 TRANSPORTATION CHARACTERISTICS (3 credits)**

Use of the concepts of volume, speed, density, and capacity to describe the characteristics and performance of surface, air, and water transportation systems.

**Prerequisite(s):** (CIVE463 or CIVE863) and (STAT3800 or MATH3800)

**CIVE 867 TRANSPORTATION SAFETY ENGINEERING (3 credits)**

Safety criteria in the planning, design and operation phases of highway, rail, airport, mass transit, pipeline, and waterway transportation systems. Background of safety legislation and funding requirements. Identification of high accident locations and methods to determine cost/effectiveness of improvements.

**Prerequisite(s):** Permission.

**CIVE 868 AIRPORT PLANNING AND DESIGN (3 credits)**

Planning and design of general aviation and air-carrier airports. Land-side components include vehicle ground access systems, vehicle circulation parking and terminal buildings. Air-side components include aircraft apron-gate area, taxiway system, runway system and air traffic control facilities and airspace. Emphasis on design projects. (Cross-listed with CIVE468)

**Prerequisite(s):** CIVE361

**CIVE 869 COMPUTER-AIDED INTERCHANGE DESIGN (3 credits)**

Principles of high-speed traffic operations, safety, and decision making related to critical design parameters used for optimal interchange geometric design through development of an interchange design project using graphical and civil engineering software.

**Prerequisite(s):** CIVE 862. Not open to non-degree graduate students.

**CIVE 871 BITUMINOUS MATERIALS AND MIXTURES (3 credits)**

Understanding of the physical, chemical, geometrical, and mechanical characteristics and practical applications of bituminous materials and mixtures. Fundamental mechanics for elastic and inelastic materials and basic theories associated with mechanical data analyses and designs. Recent advances and significant research outcomes for further discussions. Applications of theories to laboratory and field testing. (Cross-listed with CIVE 471)

**Prerequisite(s):** CIVE 378. Not open to non-degree graduate students.

**CIVE 872 PAVEMENT DESIGN AND EVALUATION (3 credits)**

Thickness design of flexible and rigid pavement systems for highways and airports; design of paving materials; evaluation and strengthening of existing pavements. (Cross-listed with CIVE 472).

**Prerequisite(s):** CIVE 334

**CIVE 875 WATER QUALITY STRATEGY (3 credits)**

A holistic approach to the selection and analysis of planning strategies for protecting water quality from nonpoint sources of contamination. An introduction to the use of methods of analyzing the impact of strategies on whole systems and subsystem for selecting strategies; and for evaluating present strategies.

**CIVE 881 COMPUTATIONAL PROBLEM SOLVING IN CIVIL ENGINEERING (3 credits)**

Introduction of numerical methods to solve problems in civil engineering, including finding roots of equations, solving linear algebra equations, optimization, curve fitting, numerical differentiation and integration, and finite difference method. Computational methods in numerical integration, matrix operations and ordinary differential equations as they apply to civil engineering problems. (Cross-listed with CIVE 481)

**Prerequisite(s):** Not open to non-degree graduate students.

**CIVE 891 SPECIAL TOPICS IN CIVIL ENGINEERING (1-6 credits)**

Special topics in emerging areas of civil engineering which may not be covered in other courses in the civil engineering curriculum.

**CIVE 894 INDEPENDENT STUDY IN CIVIL ENGINEERING (1-3 credits)**

Individual study at the masters level in a selected area of civil engineering under the supervision and guidance of a Civil & Environmental Engineering faculty member.

**CIVE 898 INDEPENDENT RESEARCH IN CIVIL ENGINEERING (1-6 credits)**

Independent research work and written findings, other than thesis or dissertation work, in a selected area of civil and environmental engineering under the supervision and guidance of a Civil & Environmental Engineering faculty member.

**CIVE 899 MASTERS THESIS (1-10 credits)**

Master's Thesis

**Prerequisite(s):** Admission to masters degree program and permission of major adviser, Not open to nondegree students.

**CIVE 916 ENVIRONMENTAL LAW AND WATER RESOURCE MANAGEMENT SEMINAR (3 credits)**

An interdisciplinary seminar with the Department of Civil Engineering. Contemporary environmental issues and water resource Management.

**Prerequisite(s):** Permission. Not open to non-degree graduate students.

**CIVE 945 STRUCTURAL ANALYSIS AND DESIGN FOR DYNAMIC LOADS (3 credits)**

Behavior of structural materials and systems under dynamic loads. Analysis and design for dynamic loads. Computational techniques. Selected laboratory demonstrations of the dynamic behavior of structural systems.

**Prerequisite(s):** CIVE 443 or CIVE 843, and CIVE 842; or permission. Not open to non-degree graduate students.

**CIVE 948 BLAST-RESISTANT STRUCTURAL DESIGN (3 credits)**

Introduction to explosion effects. Air-blast. Fragmentation. Single-Degree-of-Freedom (SDOF) analysis. Equivalent SDOF systems. Pressure-impulse diagrams. Energy solutions. Steel design. Reinforced concrete design. Masonry design. Progressive collapse. Windows and doors.

**Prerequisite(s):** CIVE842

**CIVE 949 STEEL BRIDGE DESIGN (3-6 credits)**

Analysis and design of steel bridges for short, medium-, and long-span road and water crossings. Stringer bridges. Truss, arch, cable-stayed, and suspension bridges. High performance steel and accelerated construction.

**Prerequisite(s):** (CIVE436 or CIVE836) and (CIVE446 or CIVE846). Not open to non-degree graduate students.

**CIVE 954 ADVANCED HYDRAULICS (3 credits)**

Advanced studies involving pipe and culvert hydraulics, rapidly-varied flow in open channels, sediment transport, river mechanics, control, and design.

**Prerequisite(s):** CIVE 854. Not open to non-degree graduate students.

**CIVE 958 CONTAMINANT TRANSPORT IN POROUS MEDIA (3 credits)**

Theory of flow and contaminant transport in porous media including groundwater flow, multiphase flow, equilibrium contaminant distribution, reactive transport of contaminants, and colloid transport in porous media.

**Prerequisite(s):** Permission. Not open to non-degree graduate students.

**CIVE 961 MASS TRANSIT SYSTEMS (3 credits)**

The place of mass transit in solving urban transportation problems: transit system and terminal characteristics and planning criteria. Speed, capacity, accessibility, and operation of mass transit systems. Future prospects in transit technology and case studies of existing systems.

**Prerequisite(s):** Not open to nondegree students

**CIVE 962 APPLICATION OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) TO TRANSPORTATION (3 credits)**

Geographic Information Systems (GIS) structure, function, and concepts such as spatial data models, relational databases, and spatial analyses. GIS project planning, management, and applications to transportation-related issues.

**Prerequisite(s):** Not open to nondegree students

**CIVE 963 HIGHWAY SAFETY DATA ANALYSIS (3 credits)**

Highway safety issues and appropriate accident data analysis. Quantify changes in safety when modifications are made to highways in an effort to enhance safety. Judge reported safety improvements and carry out appropriate analysis for assessing the effectiveness of safety improvements.

**Prerequisite(s):** STAT8805, not open to nondegree students

**CIVE 964 THEORY TRAFFIC FLOW (3 credits)**

Analysis of traffic characteristics as applied to traffic engineering facility design and flow optimization. Capacity of expressways, ramps, weaving sections, and intersections. Analytical approaches to flow analysis, queueing theory, flow density relationships, and traffic simulation.

**Prerequisite(s):** CIVE 866 and (STAT 3800 or STAT 8805). Not open to non-degree graduate students.

**CIVE 965 TRAFFIC CONTROL SYSTEMS (3 credits)**

Principles of traffic control. Design and analysis of intersection, arterial street, network, and freeway control systems. Traffic surveillance and driver information systems.

**Prerequisite(s):** CIVE 966 and permission. Not open to non-degree graduate students.

**CIVE 966 TRANSPORTATION PLANNING AND ECONOMICS (3 credits)**

Community growth and development based on planning decisions regarding land use whereby transportation facilities are fitted to land use. Economic studies that consider the consequences to transportation agencies, users, and nonusers. Agency expenditures, capital outlay and annual expenses for maintenance and operations. User consequences such as vehicle operating costs; commercial time costs; accident costs; discomfort and inconvenience costs; and assignment of money valuations to pleasure, recreation, and culture. Nonusers consequences items such as cost reductions or increases in public services; increases in value of crops and natural resources where areas become more readily accessible; changes in business and industrial activities; and increase or decrease of residential property values.

**Prerequisite(s):** Permission.

**CIVE 967 ANALYSIS AND DESIGN OF TRANSPORTATION SAFETY SYSTEMS (3 credits)**

Operations research techniques for modeling system performance and design of transportation services. Routing and scheduling problems. Network equilibration and partially distributed queueing systems.

**Prerequisite(s):** Not open to nondegree students

**CIVE 989 SEMINAR IN CIVIL ENGINEERING (1-6 credits)**

Current topics, research projects, and review of current literature in the various areas of civil engineering.

**Prerequisite(s):** Permission. Not open to non-degree graduate students.

**CIVE 990 CIVIL ENGINEERING SEMINAR (1-6 credits)**

Frontiers of an area of civil engineering.

**CIVE 990E CIVIL ENGINEERING SEMINAR IN ENVIRONMENTAL ENGINEERING (1-6 credits)**

Frontiers of an area of environmental engineering.

**CIVE 990M CIVIL ENGINEERING SEMINAR IN GEOTECHNICAL AND MATERIALS ENGINEERING (1-6 credits)**

Frontiers of an area of geotechnical and materials engineering.

**CIVE 990R CIVIL ENGINEERING SEMINAR IN STRUCTURAL ENGINEERING (1-6 credits)**

Frontiers of an area of structural engineering.

**CIVE 990T CIVIL ENGINEERING SEMINAR IN TRANSPORTATION ENGINEERING (1-6 credits)**

Frontiers of an area of transportation engineering.

**CIVE 990W CIVIL ENGINEERING SEMINAR IN WATER RESOURCES ENGINEERING (1-6 credits)**

Frontiers of an area of water resources engineering.

**CIVE 991 ADVANCED SPECIAL TOPICS IN CIVIL ENGINEERING (1-6 credits)**

Advanced special topics in emerging areas of civil and environmental engineering which may not be covered in other courses in the civil engineering curriculum.

**CIVE 994 ADVANCED INDEPENDENT STUDY IN CIVIL ENGINEERING (1-3 credits)**

Advanced individual study at the doctoral level in a selected area of civil engineering under the supervision and guidance of a Civil & Environmental Engineering faculty member.

**CIVE 998 ADVANCED INDEPENDENT RESEARCH IN CIVIL ENGINEERING (1-6 credits)**

Advanced independent research work and written findings, other than thesis or dissertation work, in a selected area of civil engineering under the supervision and guidance of a Civil & Environmental Engineering faculty member.

**Prerequisite(s):** Permission.

**CIVE 999 DOCTORAL DISSERTATION (1-24 credits)**

Doctoral Dissertation.

**Prerequisite(s):** Admission to doctoral degree program and permission of supervisory committee chair. Not open to nondegree students.