

# CIVIL ENGINEERING (CIVE)

## Civil Engineering Undergraduate Courses

### **CIVE 101 INTRODUCTION TO CIVIL ENGINEERING (3 credits)**

Introduction to engineering design process through hands-on projects supported by instruction of underlying engineering science and fundamentals, model development, and the required tools. Exploration of civil engineering disciplines and introduction to civil engineering profession with focus on ethics and professional skills.

### **CIVE 102 GEOMATICS FOR CIVIL ENGINEERING (3 credits)**

Introduction to the theory and application of measurements and geospatial data for civil engineering. This includes error theory, measurements of elevation, distance, direction, and location using optical, mechanical, electronic, and global navigation satellite systems, and applications in geographic information systems (GIS). Project based.

**Prerequisite(s):** CIVE 101 or CIVE 112

### **CIVE 112 INTRODUCTION TO CIVIL ENGINEERING (1 credit)**

Introduction to civil engineering as a career by use of case studies; alternate approaches to engineering designs illustrated by use of engineering principles.

### **CIVE 131 CIVIL ENGINEERING GRAPHICS (2 credits)**

Use of computer-aided design software to communicate engineering ideas. Specifications, dimensioning, tolerancing, 2- and 3-D model development, topographic mapping, and process layout with environmental, bioprocess, and biomedical emphases.

**Prerequisite(s):** CIVE 112, not open to nondegree students

### **CIVE 201 CIVIL ENGINEERING ANALYSIS I (2 credits)**

Incorporating programming logic into spreadsheet solutions in the context of authentic civil engineering projects; emphasis on integrating professional skills, data analysis and management, and technical skills. Project based.

**Prerequisite(s):** CIST 1600 (grade of C or better)

### **CIVE 202 CIVIL ENGINEERING ANALYSIS II (2 credits)**

Expanding programming logic to data analysis & visualization, solution of linear systems of equations, and ordinary differential equations. Control of sensors and visualization of scientific data. Use of authentic civil engineering projects linking engineering mechanics and materials of construction. Emphasis on integrating professional skills, data analysis, and technical skills. Project based.

**Prerequisite(s):** Prerequisite: CIST 1600 or equivalent; Corequisite: CIVE 378

### **CIVE 301 CIVIL ENGINEERING SYNTHESIS I (1 credit)**

Explores the co-disciplinary connections in civil engineering through authentic engineering projects; focus on synergies among fluid dynamics, transportation, and structures; emphasis on integrating professional skills, data analysis, and technical skills. Project based.

**Prerequisite(s):** Corequisite: CIVE 310 or CIVE 361 or CIVE 341

### **CIVE 302 CIVIL ENGINEERING SYNTHESIS II (1 credit)**

Explores the co-disciplinary connections in civil engineering through authentic engineering projects; focus on synergies among geotechnical engineering, water resources, and environmental engineering; emphasis on integrating professional skills, data analysis, and technical skills. Project based.

**Prerequisite(s):** Corequisite: CIVE 331 or CIVE 351 or CIVE 321

### **CIVE 310 FLUID MECHANICS (3 credits)**

Fluid statics, equations of continuity, momentum, and energy; dimensional analysis and dynamic similitude. Applications to: flow meters; fluid pumps and turbines; viscous flow and lubrication; flow in closed conduits and open channels. Two-dimensional potential flow.

**Prerequisite(s):** MATH 2350 (grade of C or better) and MECH 223 (grade of C or better)

### **CIVE 310L HYDRAULICS LAB (1 credit)**

Hydraulic experiments and demonstrations. Velocity, pressure and flow measurements; pipe flow, open channel flow; hydraulic structures and machinery, hydrologic and sediment measurement and student projects.

**Prerequisite(s):** CIVE 310 pre-requisite/co-requisite

### **CIVE 321 PRINCIPLES OF ENVIRONMENTAL ENGINEERING (3 credits)**

Introduction to the principles of environmental engineering, including water quality, atmospheric quality, pollution prevention, and solid and hazardous wastes engineering. Design of water, air, and waste management systems.

**Prerequisite(s):** MATH 1960 (grade of C or better), and CHEM 1180 (grade of C or better) and CHEM 1184, or CHEM 1190 (grade of C or better) and CHEM 1194

### **CIVE 321L ENVIRONMENTAL ENGINEERING LABORATORY (1 credit)**

Environmental engineering experiments, demonstrations, field trips, and projects. Experiments include the measurement and determination of environmental quality parameters such as solids, dissolved oxygen, biochemical and chemical oxygen demand, and alkalinity.

**Prerequisite(s):** Pre or Coreq: CIVE 321.

### **CIVE 331 INTRODUCTION TO GEOTECHNICAL ENGINEERING (4 credits)**

Soil composition, structure and phase relationships; soil classification. Principles of effective stress; loading induced subsurface stresses; load history; deformation and failure of soils. Elastic and limit analysis with applications to design for bearing capacity, settlement, retaining walls and slope stability. Steady state seepage.

**Prerequisite(s):** MECH 325 (grade of C or better); Coreq: CIVE 310.

### **CIVE 341 STRUCTURAL ANALYSIS FUNDAMENTALS (3 credits)**

Introduction to the analysis of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames.

**Prerequisite(s):** MECH 325 (C or better)

### **CIVE 342 STRUCTURAL DESIGN FUNDAMENTALS (1 credit)**

Introduction to structural engineering design philosophy, steel and concrete design criteria, and procedures for trusses, simple beams, continuous beams, and frames. Introduction to structural experiments and software used in structural analysis and design.

**Prerequisite(s):** MECH 325 (C or better)

### **CIVE 351 INTRODUCTION TO WATER RESOURCES ENGINEERING (3 credits)**

Introduction to water resources engineering design and planning, surface hydrology, groundwater hydraulics, reservoirs and other control structures. Introduction to field measurement and computational methods in water resources.

**Prerequisite(s):** CIVE 310 or MECH 310

### **CIVE 361 HIGHWAY ENGINEERING (3 credits)**

Introduction to the principles of highway engineering and traffic operations and control.

**Prerequisite(s):** CIVE 102 (C or better), MECH 223 (C or better)

### **CIVE 371 MATERIALS OF CONSTRUCTION (3 credits)**

Introduction to the behavior, testing and design of soil, portland cement concrete, steel, wood and composites. Experiments covering the concepts of stress and strain under axial, torsional, shear and flexural loading conditions. Common ASTM laboratory test procedures and specifications, field quality control tests and statistical applications.

**Prerequisite(s):** Prerequisite: MECH 223 (grade of C or better); Corequisite: MECH 325

**CIVE 385 PROFESSIONAL PRACTICE AND MANAGEMENT IN CIVIL ENGINEERING (3 credits)**

Basic elements of civil engineering practice. Roles of all participants in the process-owners, designers, architects, contractors, and suppliers. Basic concepts in business management, public policy, leadership, and professional licensure. Professional relations, civic responsibilities, and ethical obligations for engineering practice. Project management, contracts, allocation of resources, project estimating, planning, and controls.

**Prerequisite(s):** Junior standing and CIVE major. Not open to non-degree graduate students.

**CIVE 401 CIVIL ENGINEERING DESIGN I (3 credits)**

The first of two courses in the capstone sequence. Practical application of the engineering design process in a team project focused on an authentic and comprehensive civil engineering design project.

**Prerequisite(s):** CIVE 321, CIVE 331, CIVE 341, CIVE 351, and CIVE 361

**CIVE 402 CIVIL ENGINEERING DESIGN II (3 credits)**

The second of two courses in the capstone sequence. Practical application of the engineering design process in a team project focused on an authentic and comprehensive civil engineering design project.

**Prerequisite(s):** CIVE 401

**CIVE 419 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 819)

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

**CIVE 420 ENVIRONMENTAL ENGINEERING PROCESS DESIGN (3 credits)**

Design of unit operations and processes associated with drinking water and wastewater treatment facilities, and other environmental treatment systems.

**Prerequisite(s):** CIVE 321 and CIVE 310

**CIVE 422 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 822).

**Prerequisite(s):** Permission

**CIVE 424 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 824).

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

**CIVE 426 DESIGN OF WATER TREATMENT FACILITIES (3 credits)**

Analyses of water supplies and design of water treatment and distribution systems. (Cross-listed with CIVE 826).

**Prerequisite(s):** CIVE 420

**CIVE 427 DESIGN OF WASTEWATER TREATMENT AND DISPOSAL FACILITIES (3 credits)**

Analysis of systems for wastewater treatment and disposal. (Cross-listed with CIVE 827).

**Prerequisite(s):** CIVE 420

**CIVE 430 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 830).

**Prerequisite(s):** CIVE 326

**CIVE 434 SOIL MECHANICS II (3 credits)**

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):** CIVE 334

**CIVE 436 FOUNDATION ENGINEERING (3 credits)**

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 439 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. (Cross-listed with CIVE839)

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

**CIVE 440 REINFORCED CONCRETE DESIGN I (3 credits)**

Introduction to the design concepts of reinforced concrete building components. The design of flexural and compression members, simple walls, foundations, and floor systems using the latest American Concrete Institute (ACI) design requirements.

**Prerequisite(s):** CIVE 341

**CIVE 441 STEEL DESIGN I (3 credits)**

Introduction to the design concepts for structural steel building components. Design of tension members, bolted and welded connections, column members, and beam members. Limit states design concepts used throughout, and emphasis on behavior of members and code design procedures.

**Prerequisite(s):** CIVE 341

**CIVE 443 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 843)

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

**CIVE 444 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 844).

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

**CIVE 446 STEEL DESIGN II (3 credits)**

A continuation of the topics covered in 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, and frame stability. Introduction to connection design.

**Prerequisite(s):** CIVE 441

**CIVE 447 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 847).

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

**CIVE 451 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 851)

**CIVE 452 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 852).

**Prerequisite(s):** CIVE 352

**CIVE 454 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 854).

**Prerequisite(s):** CIVE 352

**CIVE 455 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 855).

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

**CIVE 456 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 856).

**Prerequisite(s):** CIVE 352 or permission

**CIVE 458 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 858).

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

**CIVE 459 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):** CIVE 341.

**CIVE 461 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 861).

**Prerequisite(s):** CIVE 361

**CIVE 462 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 CIVE862)

**Prerequisite(s):** CIVE361

**CIVE 463 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 CIVE863)

**Prerequisite(s):** CIVE361

**CIVE 468 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, taxi-way system, runway system and air traffic control facilities and airspace. Emphasis on design projects. (Cross-listed with CIVE868)

**Prerequisite(s):** CIVE 361

**CIVE 471 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 871)

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

**CIVE 472 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 872).

**Prerequisite(s):** CIVE 334

**CIVE 475 WATER QUALITY STRATEGY (3 credits)**

Holistic approach to the selection and analysis of planning strategies for protecting water quality from nonpoint sources of contamination. Introduction to the use of methods of analyzing the impact of strategies on whole systems and subsystems for selecting strategies; and for evaluating present strategies.

**Prerequisite(s):** Senior standing

**CIVE 476 CONSTRUCTION COST CONTROLS (3 credits)**

Development of cost accounting principles and financial controls appropriate for construction contractors. Includes purchasing policies and procedure, labor and equipment cost reporting techniques, accounting procedures for control of materials and supplies, billing methods, principles of financial reporting and analysis.

**Prerequisite(s):** ACCT 2010 and ACCT 2020.

**CIVE 481 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 881)

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

**CIVE 489 SENIOR DESIGN PROJECT (3 credits)**

Requires the formulation and completion of a civil engineering design project. Course provides senior civil engineering students with the opportunity to apply engineering concepts and principles to a comprehensive design project of multiple sub-disciplinary nature. The principal objectives are for students to develop an understanding of the entire life-cycle of civil engineering projects with emphasis on the development of a unified and sustainable design that addresses the client's needs; project team work; strong engineer-client relationships; and effective project communications.

**Prerequisite(s):** Senior standing and CIVE 385

**CIVE 491 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 494 INDEPENDENT STUDY IN CIVIL ENGINEERING (1-3 credits)**

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

**CIVE 498 INDEPENDENT RESEARCH IN CIVIL ENGINEERING (1-6 credits)**

Independent research work and written findings in a selected area of civil engineering under the supervision and guidance of a Civil & Environmental Engineering faculty member.

**Prerequisite(s):** Permission