

# CIVIL ENGINEERING (CIV-ENGR)

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## Restrictions

Courses under this subject code may have program (major, minor, certificate) specific enrollment restrictions. The Courses (<http://catalog.umkc.edu/course-offerings/undergraduate/>) section of the Catalog shows all courses offered by UMKC. Specific course restrictions are detailed in Pathway. If you have questions about your course options, please contact Roo Advising (or your academic advisor).

Please select the 'COURSES' tab above to view all courses within this subject code.

## Courses

CIV-ENGR 111 First Year Cornerstone Credit: 1

An exploration of the diverse emphasis specific career opportunities of Civil Engineers, with a goal of providing students the needed fundamental skills, knowledge and resources for identifying the most appropriate career path(s) consistent with the student's interests, skills, and objectives.

CIV-ENGR 113 Engineering Measurements Credit: 1

This course provides a fundamental introduction to the elements of surveying. Basics including terminology, coordinate systems, equipment, legal descriptions, and calculations will be taught in the classroom. Field laboratory sessions will introduce the students to setting up basic equipment, running a level loop, and laying out a site based on plan designs.

CIV-ENGR 190 Special Topics Credits: 1-3

Selected introductory topics in the area of computing. May be repeated for credit when topic varies.

CIV-ENGR 275 Engineering Statics Credits: 3

Fundamentals of statics; static equilibrium; internal forces; introduction to elements of mechanics of elastic materials, and properties of areas.

**Prerequisites:** PHYSICS 240.

CIV-ENGR 276 Strength Of Materials Credits: 3

The course introduces and emphasizes the concepts and analysis methods for stress and strain, torsion, bending and shear stresses in beams, combined stresses, and deflection theory using a calculus based methodology. Introduction to buckling and energy methods may be included.

**Prerequisites:** CIV-ENGR 275.

CIV-ENGR 318 GIS for Engineers Credits: 3

This course covers the fundamental concepts and methods for use of GIS software used to solve engineering applications and problems. The course uses module based practical learning to apply and integrate foundational knowledge, develop the skills required to model various types of imagery data, incorporate this data into projects for management and design, and provide the skills necessary for students to depict ideas and design graphically. A personal computer capable of running the software is required for the course. Non-engineering majors by instructor permission only.

**Prerequisites:** SCE Student.

CIV-ENGR 319 Engineering Computation and Statistics Credits: 3

A review of descriptive statistics, statistical distribution functions and application to engineering problems. Introduction to hypothesis testing, analysis of variance, correlation/regression and design of factorial experiments.

**Prerequisites:** MATH 268 or MATH 220.

CIV-ENGR 321 Structural Analysis Credits: 4

This course introduces the basic analysis and computer methods that are required to analyze basic structural elements and simple structures. Topics covered in this course include design loads, analysis of statically determinate beams, frames and trusses, shear and moment diagrams, influence diagrams, beam deflections, statically indeterminate structures (beams and frames), displacement methods, introduction to energy and matrix methods.

**Prerequisites:** CIV-ENGR 276.

CIV-ENGR 323 Structural Steel Design Credits: 3

Basic principles of structural steel design. Design of beams, axially loaded members, columns, and bolted and welded connections.

**Prerequisites:** CIV-ENGR 321.

CIV-ENGR 335 Soil Mechanics Credits: 3

Detailed study of physical and mechanical properties of soil governing its behavior as an engineering material. Machine Shop Safety is required prior to taking this class.

**Prerequisites:** CIV-ENGR 276, CHEM 211, CHEM 211L.

CIV-ENGR 342 Introduction to Environmental Engineering Credits: 3

Methods for determining and characterizing water quality, effects of pollution on streams and lakes, and an introduction to engineering systems for the distribution, collection and treatment of water and wastewater.

**Prerequisites:** CIV-ENGR 351 or MEC-ENGR 351; and CHEM 211 and CHEM 211L.

**CIV-ENGR 351 Fluid Mechanics Credits: 3**

Concepts of the statics and dynamics of fluids, with emphasis on principles of continuity, momentum and energy. Boundary layers, dimensional analysis and drag are covered briefly. Thorough treatment of pipe flow.

**Prerequisites:** CIV-ENGR 275.

**Co-requisites:** MATH 345 or MEC-ENGR 272.

**CIV-ENGR 357 Engineering Hydraulics Credits: 3**

Analysis and design of closed conduit systems for water supply; fundamentals of open channel flow; principles of pumping and hydropower generation; transients and control of surge pressures in pipelines.

**Prerequisites:** CIV-ENGR 351 or MEC-ENGR 351.

**CIV-ENGR 378WI Civil Engineering Materials Credits: 3**

This course provides students with a working knowledge of the design and performance of Asphaltic Concrete (AC) and Portland Cement Concrete (PCC) mixtures through understanding the properties and requirements of the component materials and their effects on subsequent performance. An understanding of the design, production process, construction, durability, and operations and maintenance will be provided. A significant portion of this course requires hands-on laboratory testing and analysis. Roadway and highway pavements will provide a primary context within which these concrete systems will be studied. Machine Shop Safety is required prior to taking this course.

**Prerequisites:** ENGLISH 225, CHEM 211, CHEM 211L, CIV-ENGR 276.

**CIV-ENGR 390 Engineering Coop/Internship Credits: 0**

Students may participate in structured Engineering Coop/Internship under the supervision of employer. They must carry out significant professional responsibilities and whatever additional assignments are determined by the employer.

**Prerequisites:** Departmental consent.

**CIV-ENGR 400 Problems Credits: 1-4**

Directed investigation of civil engineering problems.

**Prerequisites:** Departmental consent.

**CIV-ENGR 401 Topics in Civil Engineering Credits: 1-3**

Study of current and new technical developments in civil engineering.

**Prerequisites:** You must be a civil engineering student to take this course.

**CIV-ENGR 401ES Special Topics in Civil Engineering Credits: 3**

Hydraulic conductivity measurements. Seepage analysis and control. Earth dam and embankment design. Computer applications.

**Prerequisites:** CIV-ENGR 335.

**CIV-ENGR 401HA Hydrologic Analysis and Design Credits: 3**

Practical implementation of hydrologic and hydraulic system design in accordance with published design criteria and using methods and numerical modeling accepted by local, state, and national government agencies.

**Prerequisites:** CIV-ENGR 357.

**CIV-ENGR 401SD Special Topics In Civil Engineering Credits: 3**

Study of soil behavior under cyclic and dynamic loading conditions. Foundation design for vibratory loadings. Introductory earthquake engineering including dynamic ground response for determination of dynamic soil properties. Evaluation of soil liquefaction potential during earthquakes by both laboratory and in situ field methods. Design consideration for embankments and earth retaining structures under seismic loading conditions. Construction blasting and vibration effects on underground systems.

**Prerequisites:** CIV-ENGR 335.

**CIV-ENGR 404 Project Management of Integrated Design and Construction Credits: 3**

Provide a body of knowledge that includes the principles, knowledge areas, skills, and tools applicable to successful project management for the performance of integrated design and construction of capital projects, specifically as applicable to the post-award period. This post-award period is the time from the formal project award by the owner through project design and construction, testing, commissioning, close-out and completion of the project warranties.

**CIV-ENGR 405 Capital Project Delivery Methods Credits: 3**

Provide a body of knowledge that acquaints students with the capital project delivery methods in both public and private business sectors of the U.S design – construction industry. Project delivery means how a capital project comprising both design and construction is planned, procured, contracted and implemented by an owner to achieve desired objectives. Delivery methods discussed in this class include traditional design – bid- build, design – build, design-build plus added services such as operations and maintenance, CM @ Risk and other approaches. Roles and responsibilities of owners, owner consultants, and design and construction firms are presented and discussed.

**CIV-ENGR 406 Construction Project Risk Management Credits: 3**

Risk management skill sets are necessary tools for the successful project manager. Project Management Institute's (PMI) 6 steps of project risk management constitute the basis of the content, which includes an expanded knowledge of risk identification, qualitative and quantitative risk analysis, risk control, contract risks, and risk transfer options. Business and project risks such as client selection, project planning, and project execution, will be considered as well as legacy risks that remain with the business and participants beyond the project completion. Different risk management strategies will be discussed, including risk avoidance, risk mitigation, and risk transfer.

**Prerequisites:** Senior Standing.

**CIV-ENGR 409 Fundamentals of Engineering Review Credit: 1**

This course consists of a series of lectures and is intended as a review class for all the subjects included in the Fundamentals of Engineering exam. Classes specifically focus on the review of equations and formulas included in the reference handbook published by NCEES.

**CIV-ENGR 411 Civil Engineering Systems Design I Credits: 2**

Comprehensive and realistic design project using the systems approach. Design choices and their effect upon the environment. Design constraints include constructability, minimization of environmental impact and cost-effectiveness. Managerial and professional aspects of design practice.

**Prerequisites:** CIV-ENGR 467 and CIV-ENGR 497.

**Co-requisites:** CIV-ENGR 422WI and CIV-ENGR 432.

**CIV-ENGR 412 Civil Engineering Systems Design II Credits: 3**

Continuation of CIV-ENGR 411.

**Prerequisites:** CIV-ENGR 411 and departmental consent.

**CIV-ENGR 415 Engineering Leadership and Ethics Credits: 3**

Analysis of leadership, including 360-degree assessment of students' leadership. Discussion of leadership cases and application to engineering careers. Frequent analysis of engineering ethics cases using the NSPE Code.

**CIV-ENGR 417 Advanced Structural Analysis Credits: 3**

The course is designed as a continued study of structural analysis methods with emphases on indeterminate structures (trusses, beam/columns, and frames), advanced analysis methods, and introduction to nonlinear structural effects including geometric nonlinearity and inelasticity. Advanced structural analysis methods including force, displacement, matrix, energy, and limit analysis methods will be introduced and practiced. Both computer based and hands-on analysis will be involved.

**Prerequisites:** CIV-ENGR 321

**CIV-ENGR 421 Matrix Methods of Structural Analysis Credits: 3**

The basic components of this class are matrix theories and applied computer analysis methods using a computer-based structural analysis software. These include: (1) study of matrix formulation of direct stiffness method, virtual work principle and formulation of displacement-based frame elements, theories and significance of geometric and material nonlinearity; (2) Sap2000-based analysis of 2D/3D trusses and 2D/3D frames considering different loading and material/geometric nonlinearity.

**Prerequisites:** CIV-ENGR 321.

**CIV-ENGR 422WI Reinforced Concrete Design Credits: 3**

Basic principles of reinforced concrete design. Design of beams for flexure and shear; design of short and slender columns. Bond stress development. Footing design.

**Prerequisites:** ENGLISH 225 and CIV-ENGR 321.

**CIV-ENGR 423 Advanced Structural Steel Design Credits: 3**

Design of steel structures and bridges. Topics include composite beams, plate girder design, and moment resistant connections.

**Prerequisites:** CIV-ENGR 323.

**CIV-ENGR 425 Prestressed Concrete Credits: 3**

Design and behavior of prestressed concrete structures; material and system of pretensioned and post tensioned systems; prestress losses; flexure, shear, bond, deflections and partial prestress in determinate structures; indeterminate beams-introduction.

**Prerequisites:** CIV-ENGR 422WI.

**CIV-ENGR 427 Advanced Reinforced Concrete Design Credits: 3**

Advanced topics in the design of footings, retaining walls, two-way floor slabs, torsion and continuous structures, shear friction, strut and tie design, precast design.

**Prerequisites:** CIV-ENGR 422WI.

**CIV-ENGR 429 Design of Structures for Blast and Fire Credits: 3**

General overview of Blast Design; risk assessment and design criteria; simplified Blast Effects Analysis; ground shock, material response; antiterrorism design considerations; weapons effects and mitigation; internal explosions; progressive collapse analysis; and introduction to Fire Design.

**CIV-ENGR 431 Fundamentals of Geomaterial Characterization Credits: 3**

A geomaterial is any construction material comprised primarily of soil. This course overviews state-of-the-art instrumental techniques for analysis of the physio-chemical properties of soils, aggregates, hydraulic concrete, and asphaltic concrete. Evaluation techniques will be applied to determining beneficial reuse opportunities for industrial by-product materials from the Kansas City region.

**Prerequisites:** CIV-ENGR 335, CIV-ENGR 378WI.

**CIV-ENGR 432 Foundation Engineering Credits: 3**

Design of basic foundation structures, footings, retaining walls, pile foundations, dams.

**Prerequisites:** CIV-ENGR 335.

**CIV-ENGR 436 Advanced Soil Mechanics Credits: 3**

Theoretical soil mechanics as applied to solution of specific engineering problems.

**Prerequisites:** CIV-ENGR 335.

**CIV-ENGR 442 Hydraulic Structures Credits: 3**

A review of the history and hydraulic design procedures for a variety of hydraulic structures including spillways, water measurement structures, canal structures and energy dissipation structures.

**Prerequisites:** CIV-ENGR 357.

**CIV-ENGR 443 Hazardous Waste Management Credits: 3**

Engineering principles involved in handling, collection, transportation, processing and disposal of hazardous wastes, waste minimization, legislation on hazardous wastes and groundwater contamination.

**Prerequisites:** School of Science and Engineering Student.

**CIV-ENGR 446 Limnology Credits: 3**

Physical, biological and chemical issues important in surface fresh waters. Includes carbonate chemistry, algal assay and thermocline analysis.

**Prerequisites:** CHEM 211, MATH 345.

**CIV-ENGR 447 Legal Topics for Engineers Credits: 3**

This course covers a broad range of substantive legal topics giving the student a grounding in the legal implications of certain situations that they may encounter during their careers. The course includes coverage of basic contract law, environmental regulations and compliance, construction law, antitrust law, intellectual property law, civil procedure, employment law, business entities (corporate law) product liability and criminal law and procedure. The objective of the course is to provide students with a fundamental understanding of the wide range of federal and state laws governing behavior in our complicated and rule of law driven society.

**Prerequisites:** Senior standing.

**CIV-ENGR 449 Environmental Compliance, Auditing and Permitting Credits: 3**

This course provides a high level overview of the most important statutes that have been enacted to protect the environment. The course covers regulation of hazardous waste, the Clean Air and Clean Water Acts, the Resource Conservation and Recovery Act, the All Appropriate Inquiry Rule and the law addressing sites contaminated with hazardous substances and the technology options employed to remediate those sites. In addition, the course provides coverage of environmental audits and emergency planning for extremely hazardous substances, the regulation of underground storage tanks, safe drinking water and the National Environmental Policy Act among other statutes.

**Prerequisites:** Senior standing.

**CIV-ENGR 452 Introduction to River Engineering Credits: 3**

This is a first course in the fundamentals of open channel (free surface) water flow. Over ninety-nine percent of all the water that is moved on the planet's surface is by free surface flow. Study of free surface flow is essential to the study of storm water drainage systems, flood control, water and wastewater treatment and the study of the form and processes of river evolution. This class provides the fundamental physical principles of free surface flow as a prelude to a significant number of other topics that pertain to engineering and geomorphic analysis.

**Prerequisites:** CIV-ENGR 357.

**CIV-ENGR 453 Hydraulics and Variability of Rivers Credits: 3**

Introduction to the concepts of alluvial channel behavior, evolution and change due to natural and man-induced modifications to streams and watersheds. Numerous case studies of river behavior are studied from the perspective of hydraulics, geomorphology and sediment transport.

**Prerequisites:** CIV-ENGR 357.

**CIV-ENGR 454 River Stability and Scour Credits: 3**

Bridge hydraulics, stream stability, scour at bridge piers and abutments, hydraulic modeling of floods, countermeasures for protection of bridge infrastructure.

**Prerequisites:** CIV-ENGR 351 or MEC-ENGR 351.

**CIV-ENGR 456 Urban Hydrology Credits: 3**

Analysis of urban drainage systems in accordance with published municipal criteria. This course is an in-depth course for senior undergraduate students interested in the hydrological sciences and for graduate students specializing in water resources. Specifically this course will focus on the engineering procedures and techniques specified by municipalities to design and maintain efficient, safe, storm drainage systems. This course also focuses on the unique issues associated with estimating and designing for rainfall/runoff in urban metropolitan areas, including channel and reservoir routing of floods through stream channels, retention structures, culverts, and storm sewers.

**Prerequisites:** CIV-ENGR 357.

**CIV-ENGR 463 Construction Law Credits: 3**

This course introduces professional, ethical, and legal concepts of the professional practice of engineering, and the role of the consulting engineer, specifically in the A/E/C industry during the design, procurement, and construction processes. A conceptual framework is developed for understanding the industry standard agreements (AIA, EJCDC, ConCensus) and the various participants roles and duties in project execution. The engineer's "professional standard of care" is examined and revisited throughout the semester, specifically what it means to be a "Professional Engineer". Emphasis is placed on project and contract management and the applicable law.

**CIV-ENGR 466 Green Building and Sustainable Infrastructure Credits: 3**

This class will discuss various green rating systems for buildings and infrastructure. Upon completion of this course students will be prepared for the LEED Green Associate Exam. The course will also discuss infrastructure project sustainability from a life cycle perspective. A semester project will involve stormwater management using 'green' techniques and methods to mitigate the urban heat island. Upon completion of the course, students will better understand what sustainability means and how it applies in the context of our built environment and have a good idea of how technology will impact our sustainable future.

**Prerequisites:** Junior standing.

**CIV-ENGR 467 Introduction to Construction Management Credits: 3**

Structure of the construction industry; construction drawings and specifications; estimating and bidding; construction contracts, bonds and insurance; planning and scheduling of construction operations; project management; computer techniques.

**CIV-ENGR 468 Construction Planning and Scheduling Credits: 3**

This course is intended to provide an in-depth examination of the construction planning and scheduling process, as it relates to civil engineering projects. Topics will include planning and scheduling of construction operations by the critical path method, Network diagramming, scheduling computations, and time-cost trade-offs. Manpower and equipment leveling. Computer and noncomputer techniques.

**Prerequisites:** CIV-ENGR 467.

**CIV-ENGR 469 Construction Methods and Equipment Credits: 3**

Introduction to methods used to plan, construct, and manage heavy civil projects. Topics will include development, project control, equipment productivity, earthmoving fundamentals, formwork design, and other issues in heavy civil projects.

**Prerequisite:** CIV-ENGR 467.

**CIV-ENGR 470 Corrosion Engineering Credits: 3**

This course will cover the physical interaction of metallic materials with their environments, called corrosion. Corrosion is an electrochemical process and the thermodynamics and kinetics of corrosion processes will be discussed. Students will be expected to identify different forms of corrosion and be able to select appropriate materials for their working environment to prevent corrosion related problems. Second half of the class will concentrate on corrosion of metals in concrete and prevention methods.

**Prerequisites:** CHEM 211, CHEM 211L, CIV-ENGR 378WI.

**CIV-ENGR 471 Advanced Portland Cement Concrete Credits: 3**

This course will cover topics such as cement chemistry, concrete proportioning, aggregates, mineral and chemical admixtures, fresh and hardened properties of concrete, and durability of concrete. Design and proportioning of concrete mixtures for desired fresh and hardened properties will be emphasized. Specialty concrete types such as high strength/high performance concrete, lightweight concrete, pervious concrete, high volume fly ash concrete, and fiber reinforced concrete will also be covered.

**Prerequisites:** CHEM 211, CHEM 211L, CIV-ENGR 378WI.

**CIV-ENGR 473 Durability of Civil Engineering Materials Credits: 3**

This course will explore the identification, causes of, and remediation of material-related durability deterioration in civil engineering projects. The primary focus will be on reinforced concrete, plain concrete, and soil for a variety of applications. Course content will be delivered primarily through laboratory activities and handouts. Lab activities will use advanced analysis techniques and help the students identify and measure deterioration mechanisms. Various non-destructive evaluation techniques will be discussed. Students have hands on experiences with samples production, data collection, and data analysis for all of the lab activities.

**Prerequisites:** CIV-ENGR 335, CIV-ENGR 378WI.

**CIV-ENGR 475 Seismic Design of Structures Credits: 3**

Introduction to basic analysis and design principles for the seismic design of buildings (concrete, steel, wood). General seismic principles, codes and loads, static lateral force procedure, dynamic lateral force procedure, topics in rigidities of buildings.

**Prerequisites:** CIV-ENGR 323 (or CIV-ENGR 422WI), and MEC-ENGR 285.

CIV-ENGR 481 Introduction to Transportation Credits: 3

Principles of highway engineering and traffic analysis, road/vehicle performance, geometric alignment of highways, traffic analysis and queuing theory, signal design, statistical analysis of traffic data and highway drainage.

CIV-ENGR 484 Pavement Materials Design, Maintenance, and Rehabilitation Credits: 3

Traffic loading and volume, stress and deflection, characterization of pavement materials, design of flexible and rigid pavements, design of overlays, evaluation of pavement performance, maintenance techniques, and rehabilitation options.

**Prerequisites:** CIV-ENGR 335, CIV-ENGR 378WI.

CIV-ENGR 487 Applied Finite Element Analysis Credits: 3

The study of advanced simulation techniques for the solution to engineering problems. The use of Finite Element Method toward solving mechanical, structural, vibration and potential flow problems will be explored. Current commercial simulation tools will be used extensively.

**Prerequisites:** MEC-ENGR 272 and MEC-ENGR 130.

CIV-ENGR 491 Internship Credits: 6

For International students who must register to cover off-campus employment which is approved as related to their degree by their departmental advisor and ISAO.

**Prerequisites:** Departmental consent.

CIV-ENGR 497 Engineering Hydrology Credits: 3

Fundamental concepts of hydrology in engineering; computation principles of runoff from rainfall; measurement of hydrologic quantities; quantitative and statistical estimation of design stream-flow magnitude and frequency; principles of unsteady routing of hydrographs.

**Prerequisites:** CIV-ENGR 319; and CIV-ENGR 351 or MEC-ENGR 351.