CIVIL ENGINEERING

The Department of Civil Engineering (https://www.uakron.edu/engineering/CE/) offers an undergraduate program leading to the Bachelor of Science in Civil Engineering. The department also offers programs leading to the Associate of Applied Science and the Bachelor of Science in Construction Engineering Technology, the Associate of Applied Science in Construction Field Operations, the Associate of Applied Science in Land Surveying, and the Bachelor of Science in Surveying and Mapping, as well as a number of certificates. The department offers graduate programs leading to a Master of Science in Civil Engineering, and an interdisciplinary Doctor of Philosophy in Engineering, along with graduate-level certificate programs for practicing professionals.

Information specific to the available program options in civil engineering is available:

- Civil Engineering, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/civil-engineering-bs/)
- Construction Engineering Technology, AAS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/construction-engineering-technology-aas/)
- Construction Engineering Technology, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/construction-engineering-technology-bs/)
- Construction Field Operations, AAS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/construction-field-operations-aas/)
- Construction Field Operations, Certificate (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/construction-field-operations-certificate/)
- Geographic and Land Information Systems, Certificate (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/geographic-land-information-certificate/)
- Land Surveying, AAS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/land-surveying-aas/)
- Surveying and Mapping, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/surveying-mapping-bs/)
- Surveying for Civil Engineers, Certificate (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/surveying-civil-engineers-certificate/)
- Surveying, Certificate (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/civil-engineering/surveying-certificate/)
- Science, Construction Management Option, AS (https://bulletin.uakron.edu/undergraduate/colleges-programs/arts-sciences/interdisciplinary-programs/associate-science-construction/)

Surveying and Mapping (SURV)

SURV 100 Introduction to Geomatics (2 Units)
An introductory course into the field of surveying and mapping technology. Integrated topics include: types of surveys, cartography, and geographic information systems. (Formerly 2980:100)

SURV 101 Basic Surveying (3 Units)
Pre/Corequisite: MATH 143 or MATH 144 or higher math or placement. Care and use of basic surveying field instruments and the basic computations and adjustments necessary to post process the field survey measurements. Field Practice. (Formerly 2980:101)

SURV 102 Topographic Surveying (2 Units)
Prerequisite: SURV 101. Pre/Corequisite: MATH 149 or MATH 154 or higher math or placement in higher math. Computations and adjustments of field survey measurements using both conventional and computer methods. Development of maps and plans stressed. Field Practice. (Formerly 2980:102)

SURV 105 Introduction to Geographic & Land Information Systems (3 Units)
Introduction to the principles and concepts of Geographic and Land Information Systems used in surveying and mapping applications. Laboratory. (Formerly 2985:101)

SURV 123 Surveying Field Practice (2 Units)
Prerequisite: SURV 102 or equivalent. Practical experience in use of surveying equipment and methods of surveying. Provides students with responsibility for making decisions and planning and directing complete project. (Formerly 2980:123)

SURV 155 Computer Applications in Surveying (3 Units)
Use of current surveying software to solve typical problems/projects in surveying technology. (Formerly 2980:155)

SURV 170 Surveying Drafting (3 Units)
Pre/Corequisite: MATH 152, MATH 153, MATH 143, MATH 144, MATH 145 or higher math, or higher math placement. Drafting procedures, techniques, and tools required for the various phases of survey office work. Projects include topographic maps, plan and profile drawings, and cross-section drawings. Laboratory. (Formerly 2980:170)

SURV 201 Intermediate Geographic and Land Information Systems (3 Units)
Prerequisite: SURV 105. Continued instruction in the hands-on technical applications of Geographic and Land Information Systems. Laboratory. (Formerly 2985:201)

SURV 205 Building Geodatabases (3 Units)
Prerequisite: SURV 105. Introduction and application of spatial geodatabases. The student will create, use, and manage geodatabases. Geodatabases are used for storing spatial and attribute data. Laboratory. (Formerly 2985:205)

SURV 222 Construction Surveying (3 Units)
Prerequisite: SURV 101. Methods and procedures for establishing line and grade for construction. Circular and parabolic curves. Cross-sectioning methods and earthwork. Communication and plan reading. (Formerly 2980:222)

SURV 223 Geospatial Technologies (3 Units)
Introduction to current and emerging geospatial technologies, such as Geographic Information Systems, remote sensing and global positioning systems, and exploring mapping data sources. Laboratory required. (Formerly 2980:223)

SURV 225 Advanced Surveying (3 Units)
Prerequisite: SURV 101. Introduction to flood maps, ALTA surveys, and geodesy. Advanced topics in control surveys, state plane coordinates, and bearings from celestial observation. (Formerly 2980:225)

SURV 228 Boundary Surveying (3 Units)
Prerequisite: SURV 101 or equivalent. Analysis of evidence and procedures for boundary location; establishing and/or locating points for boundary and mortgage location surveys; plat preparation. Ohio survey minimum standards. (Formerly 2980:228)

SURV 251 CST Seminar (1 Unit)
Prerequisite: SURV 222. Prepares students for the National Society of Professional Surveyors Certified Surveying Technician (CST) Level I Examination. Examination is given at the end of the review sessions. (Formerly 2980:251)

SURV 310 Survey Computations & Adjustments (2 Units)
Prerequisite: SURV 225. Concepts relating to measurement error, probability, and reliability. Computation and adjustment of horizontal and vertical networks. (Formerly 2980:310)

SURV 315 Boundary Control & Legal Principles (3 Units)
Prerequisite: SURV 228. Historical development of boundaries, rectangular system of public land surveys, systems to describe property, surveyor's responsibility to understand and properly apply legal principles to boundary. (Formerly 2980:315)

SURV 325 Safety for Surveyors (1 Unit)
To provide safety and first aid training required for surveying. (Formerly 2980:325)

SURV 330 Applied Photogrammetry (3 Units)
An introduction to metrical and quantitative photogrammetry using both hard- and soft-copy systems. Laboratory. (Formerly 2980:330)

SURV 335 The Business of Surveying (2 Units)
A course focused on the business aspects of surveying, including development of business plan components for a company offering professional surveying and mapping services. (Formerly 2980:335)

SURV 340 Cadastral Surveying (2 Units)
Prerequisites: SURV 101. A study of the official surveys of the United States. Cadastral surveys establish or recreate boundaries and /or tracts of land. (Formerly 2980:340)

SURV 350 Mapping with Drones (3 Units)
An introduction to Unmanned Aircraft Systems (UAS) and its associated applications as it relates to land surveying and mapping. (Formerly 2980:350)

SURV 410 LiDAR and Laser Scanning (2 Units)
Prerequisite: SURV 105. Introduction to LiDAR (aerial and terrestrial) scanning as it applies to surveying and mapping. The course will discuss the collection and dissemination methods of the data. (Formerly 2980:410)

SURV 415 Legal Aspects of Surveying (3 Units)
Prerequisite: SURV 315. A study of statute and common law related to land surveying. Evidence and the surveyor's role in the judicial process. Interpreting and writing land descriptions. (Formerly 2980:415)

SURV 420 Route Surveying (3 Units)
Prerequisite: SURV 225. Surveying for long but narrow strips of land such as highways, railroads, and pipe lines. Course includes all requisite calculations and drawings. (Formerly 2980:420)

SURV 421 Subdivision Design (3 Units)
Prerequisites: SURV 155, SURV 222, and SURV 315. Site analysis, land use controls, and plotting procedures. Laboratory includes preparation of various types of projects leading to a complete subdivision. (Formerly 2980:421)

SURV 422 Global Positioning System Surveying (3 Units)
Prerequisite: SURV 225. Introduction to the Global Positioning System (GPS). Course includes the planning, data collection, and processing of GPS data. (Formerly 2980:422)

SURV 425 Land Navigation (3 Units)
Interpretation and use of topographic maps. Study of basic map elements with emphasis on identification of features and coordinate systems. Map use for land navigation. (Formerly 2980:425)

SURV 426 History of Surveying To 1785 (2 Units)
A history of land surveying. Emphasis on the development of survey procedures through history. Part I (to 1785) covers the ancient world to the colonial period. (Formerly 2980:426)

SURV 427 Ohio Lands (2 Units)
Study of the history of the original Ohio Land Subdivisions (Formerly 2980:427)

SURV 428 History of Surveying Since 1785 (2 Units)
A history of land surveying. Emphasis on the development of survey procedures through history. Part II (Since 1785) covers the history of the United States to date. (Formerly 2980:428)

SURV 430 Surveying Project (3 Units)
Prerequisite: Senior standing and placement of advisor. Provides opportunity to research and develop a specific surveying project within chosen area of surveying. Oral, written and graphical presentation of completed project(s). (Formerly 2980:430)
Gen Ed: Capstone

SURV 431 Senior Seminar (2 Units)
Prerequisite: Senior or greater standing. Students demonstrate knowledge and skills acquired as surveying majors through assessment testing and review of professional licensure laws. Preparation for national exams. (Formerly 2980:431)

SURV 445 Applications in GIS using GPS (3 Units)
Prerequisite: SURV 105. Advanced instruction in GIS applications using GPS as well as other surveying and mapping methods. Laboratory. (Formerly 2980:445)

SURV 450 Topics in Professional Practice (2 Units)
Prerequisite: Junior or greater standing. Topics in applicational areas of surveying from the point of view of the practitioner and the consumer of land-related data. (Formerly 2980:450)

SURV 489 Special Topics in Surveying (1-3 Units)
Prerequisite: Permission. Special lecture/laboratory courses offered once or only occasionally in areas where no formal course exists. (May be repeated for a maximum of six credits.) (Formerly 2980:489)

SURV 490 Workshop in Surveying (1-3 Units)
Prerequisite: Permission. Group study of special topics in surveying. May not be used to meet undergraduate major requirements in surveying. May be used for elective credit only. (May be repeated for a maximum of six credits.) (Formerly 2980:490)

SURV 495 Internship: Surveying and Mapping (3 Units)
Prerequisites: 64 hours in program and permission. Supervised work experience in surveying and mapping to increase student understanding of surveying and mapping technology. (Formerly 2980:495)

SURV 497 Surveying Honors Project (3 Units)
Prerequisite: Senior standing in the honors program. Provides opportunities to research and develop a specific surveying project within chosen area of surveying. Oral, written, and geographical presentation of completed projects. (Formerly 2980:497)

SURV 498 Independent Study (1-3 Units)
Prerequisite: Permission or instructor. Directed study in a special field of interest chosen by student in consultation with instructor. (May be repeated for a total of six credits). (Formerly 2980:498)

Construction Engineering Technology (COET)

COET 125 Statics (3 Units)
Prerequisites: [MATH 149 or MATH 154 or higher math or placement in higher math] and [PHYS 160, PHYS 261, or PHYS 291]. This course covers forces, resultants, and couples. Equilibrium of force systems. Trusses, frames, centroid, moment of inertia, and friction. (Formerly 2990:125)

COET 129 Professional Topics in Construction (3 Units)
This course introduces students to important professional topics and computing skills for construction managers including software for estimating, scheduling, presentations, general business administration and graphics. (Formerly 2990:129)

COET 131 Building Construction (2 Units)
Materials and methods used in construction. Encompasses buildings constructed with wood, steel, concrete or a combination of these materials. (Formerly 2990:131)

COET 150 Plan Reading (3 Units)
Pre/Corequisite: MATH 143, MATH 144, MATH 145 or higher or placement. The language of construction. Symbols, scales, plan views, elevation views, sections and details. Quantity take-off estimation. (Formerly 2990:150)

COET 225 Strength of Materials (3 Units)
Prerequisite: COET 125. Stress, strain and stress-strain relationships. Tension, compression, torsion, beams. Shear and moment diagrams. Combines stresses. (Formerly 2990:225)

COET 226 Construction Supervision (3 Units)
Introduction to topics on construction supervision including planning, directing and coordinating onsite activities to build quality defined by drawings and specifications. (Formerly 2990:226)

COET 234 Elements of Structures (3 Units)
Prerequisites: COET 125 and COET 225. Principles of stress and structural analysis, concepts of steel, timber design, and reinforced concrete. (Formerly 2990:234)

COET 235 Construction Inspection (3 Units)
Prerequisite: COET 131. Fundamentals of total quality management and construction inspection. (Formerly 2990:235)

COET 237 Materials Testing I (2 Units)
Prerequisite: MATH 153, MATH 143, MATH 144, MATH 145 or higher math, or higher math placement. Laboratory testing of soils with emphasis on physical properties of soil. Laboratory and field procedures used for quality control. (Formerly 2990:237)

COET 238 Materials Testing II (2 Units)
Prerequisite: MATH 153, MATH 143, MATH 144, MATH 145 or higher math, or higher math placement. Mix design of concrete. Laboratory testing of concrete containing ordinary Portland cement and pozzolanic admixtures. Experiments demonstrate physical properties as related to design and quality control. (Formerly 2990:238)

COET 239 Construction Geomechanics (3 Units)
This course provides an understanding of the impact of the mechanical behavior and engineering properties of soils and rock related to construction processes and methods. Topics include erosion control, laboratory test methods for engineering design, flood and mass wasting behavior, soil subsidence, and sustainability of engineered coastal structures. (Formerly 2990:239)

COET 245 Construction Estimating (3 Units)
Prerequisites: [MATH 149 or MATH 154 or higher math, or placement in higher math] and COET 150. Quantity takeoffs in construction to include mass excavations, foundation systems, structural steel, residential construction, and various commercial construction methods. (Formerly 2990:245)

COET 246 Site Engineering (3 Units)
Prerequisite: MATH 153, MATH 143, MATH 144, MATH 145 or higher math, or higher math placement. The content includes study of the development of a site including surveying, excavation, soil treatment, heavy equipment requirements, storm water management, pavement design, and construction of roadways. (Formerly 2990:246)

COET 254 Building Codes (3 Units)
Prerequisite: COET 131. Students learn fundamental concepts for construction related to the residential building code. (Formerly 2990:254)

COET 310 Residential Building Construction (3 Units)
Introduction to building design, wood framing, and mechanical systems as commonly found in residential housing. (Formerly 2990:310)

COET 352 Field Management & Scheduling (2 Units)
Prerequisite: COET 245 or permission. Planning, scheduling, and controlling of field work within time and cost constraints. Manual methods and computer software packages studied. (Formerly 2990:352)

COET 354 Foundation Construction Methods (3 Units)
Prerequisites: COET 225 and COET 237. Soil mechanics and soils exploration as related to construction. Foundation construction methods and practice in the interest of safety and suitable economy. (Formerly 2990:354)

COET 356 Safety in Construction (3 Units)
The purpose of this course is to explain what creates hazards and why, and to suggest where to anticipate trouble in each phase of the work as it progresses. (Formerly 2990:356)

COET 358 Advanced Estimating (3 Units)
Prerequisite: COET 245. This course focuses on estimating and bidding for public and private construction. Includes heavy/highway, residential and building construction with use of computer software to facilitate bid price. (Formerly 2990:358)

COET 361 Construction Formwork (3 Units)
Prerequisite: COET 234 or permission. Introduction to design and construction of formwork and temporary wood structures. (Formerly 2990:361)

COET 371 Green & Sustainable Building Practices (3 Units)
This course is designed to provide an understanding of sustainable construction practices and their importance on environmental issues. (Formerly 2990:371)

COET 421 Risk Management and Contract Strategies (3 Units)
Prerequisite: Admission to the BSCET program, or permission from program director. This course focuses on current trends and challenges related to construction contracting. Students will learn critical “issue spotting” skills in areas of construction risk management, loss avoidance, collaboration, and strategic thinking. (Formerly 2990:421)

COET 422 Leveraging AI and Construction Technologies (3 Units)
Prerequisites: Junior or greater standing and admission to an engineering major within the College of Engineering and Polymer Science. This course we will describe how to use emerging trends and technologies to improve project outcomes. Topics include digital and computing technologies - AI and cloud computing, BIM, video and laser scanning, big data and data analytics, reality capture, blockchain, simulation, augmented reality, data standards and interoperability, and vertical and horizontal integration, industrial production - prefabrication, 3D printing and assembly, offsite manufacture, cyber-physical systems - actuators, sensors, IoT, robots, cobots, and drones. (Formerly 2990:422)

COET 442 Lean Building Science (3 Units)
Prerequisite: Admission to the BSCET program. This course is designed to provide an understanding of collaborative leadership and lean building science is it relates to job site construction safety, building first cost, schedule, ongoing building operating expenses, and upcycle construction benefits. Students will work in classroom and workshop settings led by construction industry leaders and subject matter experts. There will also be the opportunity to experience job site application of these practices. Core concepts will be taught through a variety of methods, such as learning checks, peer presentations, videos, social media posts and smaller group projects. Students will learn a variety of tools they can apply immediately to their work to reduce waste and improve the overall efficacies of their organizations. (Formerly 2990:442)

COET 453 Legal Aspects of Construction (2 Units)
Prerequisite: Admission into the BCET program or permission. Study of business of contracting and subcontracting and legal problems therein such as breach, partial performance, payment, insolvency, subsurface. Review of standard contracts and construction industry rules of arbitration. (Formerly 2990:453)

COET 462 Mechanical Service Systems (3 Units)
Introduction to materials and equipment used in mechanical heating, ventilating, air conditioning, water and waste systems. (Formerly 2990:462)

COET 463 Electrical Service Systems (3 Units)
Introduction to materials and equipment in electrical systems of buildings. Includes illumination, electrical sources, materials and distribution. Emphasis of fire safety. (Formerly 2990:463)

COET 465 Heavy Construction Estimating (3 Units)
Prerequisite: COET 245. Quantity takeoffs and cost analysis to include methods, systems, and equipment relevant to heavy highway and civil infrastructure projects. (Formerly 2990:465)

COET 466 Hydraulics (3 Units)
Prerequisite: Junior or greater standing. Pre/Corequisite: MATH 356. Introduction to hydrology. Flow in closed conduits and open channels, distribution, systems, storage requirements and basic concepts of hydraulic structures. Basic concepts of seepage and working knowledge of pumps. (Formerly 2990:466)

COET 468 Construction Management (3 Units)
Prerequisites: COET 352 and COET 358. Construction Management takes established construction practices, current technological advances, and latest management methods and makes them into an efficient, smooth working system. (Formerly 2990:468)
Gen Ed: Capstone

COET 469 Contracts and Specifications (3 Units)
Prerequisite: Admission to BSCET program or permission. This course studies the principles and applications of construction specifications, contracts, processes for managing professional risk and increasing economic performance of the construction process. (Formerly 2990:469)

COET 489 Special Topics in Construction (1-3 Units)
Prerequisite: Permission of instructor. (May be repeated for up to six credits.) Special lecture/laboratory courses offered once or only occasionally in areas where no formal courses exist. (Formerly 2990:489)

COET 490 Workshop in Construction (1-3 Units)
Prerequisites: Permission. Group studies of special topics in construction. May not be used to meet undergraduate major requirements in construction. May be used for elective credit only. (May be repeated for up to six credits) (Formerly 2990:490)

COET 497 Honors Project (1-3 Units)
Prerequisite: Senior standing in Honors College and permission of supervising faculty in student's degree field and pursuit of major in CET. Individual Senior Honor's Project relevant to student's major field of study. Specific projects are approved and supervised by a designated member of the faculty in the student's degree field. (Formerly 2990:497)

COET 498 Independent Study in Construction (1-3 Units)
Prerequisite: Permission. Directed study in a special field of interest chosen by student in consultation with instructor. (May be repeated for up to six credits) (Formerly 2990:498)

Civil Engineering (CIVE)

CIVE 101 Introduction to Civil Engineering Fundamentals (3 Units)
Corequisite: MATH 149 or higher math or appropriate AP test score. Introduction to Civil Engineering. Basic concepts of civil engineering practice including communication skills, problem solving skills, professional ethics/goals, and teamwork. Introduction to professional level software including spreadsheets, database, and mathematical computation. (Formerly 4300:101)

CIVE 102 Tools for Civil Engineering (3 Units)
Prerequisite: CIVE 101. Building on concepts of engineering practices learned in Tools I further developing communication skills, problem solving skills, professional ethics/goals, statistics and model-building, and teamwork. Advanced use of professional level software including CAD, MATLAB and Excel. (Formerly 4300:102)

CIVE 201 Engineering Statics (3 Units)
Pre/Corequisites: MATH 222 and PHYS 291. Forces, resultants, couples; equilibrium of force systems; distributed forces; centers of gravity, analysis of simple structures; moments of inertia; kinematics. (Formerly 4300:201)

CIVE 202 Introduction to Mechanics of Solids (3 Units)
Prerequisite: CIVE 201. Axial force, bending moment diagrams, axial stress and deformation; stress-strain diagrams; torsion; flexural stress; flexural shearing stress; compound stresses; indeterminate beams; columns. (Formerly 4300:202)

CIVE 306 Theory of Structures (3 Units)
Prerequisite: CIVE 202. Stability and determinacy; statically determinate trusses and frames; approximate frame analysis influence lines; moving loads; virtual work analysis; moment area theorem; theorem of three moments; moment distribution for continuous beams and frames. (Formerly 4300:306)

CIVE 313 Soil Mechanics (3 Units)
Prerequisites: CIVE 202 and admission to an engineering major within the College of Engineering and Polymer Science or permission. Physical properties of soils. Soil water and groundwater flow. Stresses, displacements, volume changes, consolidation within a soil mass. Soil strength. Compaction. (Formerly 4300:313)

CIVE 314 Foundation Design (3 Units)
Prerequisites: CIVE 313 and full admission to an engineering major in the College of Engineering and Polymer Science. Subsurface exploration, shallow foundations, earth retaining structures, deep foundations (Formerly 4300:314)

CIVE 321 Introduction to Environmental Engineering (3 Units)
Prerequisites: CHEM 153 and MATH 222. Basic principles of ecosystems, microbiology, chemical reactions, and material flow that environmental engineers use to protect our water, air and soil. (Formerly 4300:321)

CIVE 323 Water Supply & Pollution Control (3 Units)
Prerequisite: CIVE 321 and admission to an engineering major within the College of Engineering and Polymer Science. Pre/Corequisite: MATH 335. Water and wastewater characteristics, criteria, quantities and distribution. Water and wastewater treatment process flowsheets, design and operation. Wastewater and residue disposal. (Formerly 4300:323)

CIVE 341 Hydraulic Engineering (3 Units)
Prerequisites: MECE 310 and admission to an engineering major within the College of Engineering and Polymer Science. This course will focus on presentation and application of fundamental hydraulic principles in both the classroom and laboratory. Examination of flow in pipelines and pipe networks, pumps and pumping stations, hydrology, flow in open channels, groundwater hydraulics, and design of hydraulic structures will be studied. Emphasis will be placed on proper application of principles, data interpretation and analysis, problem solving, and report writing. (Formerly 4300:341)

CIVE 361 Transportation Engineering (3 Units)
Prerequisites: Junior standing and admission to an engineering major within the College of Engineering and Polymer Science. Introductory survey of transportation topics including transportation planning requirements and techniques, introduction to design of highways, airports and railroads and introduction to traffic engineering. (Formerly 4300:361)

CIVE 380 Engineering Materials Laboratory (3 Units)
Prerequisites: CIVE 202 and admission to an engineering major within the College of Engineering and Polymer Science. Fundamentals and applications of materials science, mechanics of solids and study of laboratory instrumentation and standard techniques in testing of engineering materials. (Formerly 4300:380)

CIVE 401 Steel Design (3 Units)
Prerequisites: CIVE 306 and admission to an engineering major within the College of Engineering and Polymer Science. Tension, compression members; open web joists; beams; bearing plates; beam-columns; bolted, welded connections. (Formerly 4300:401)

CIVE 403 Reinforced Concrete Design (3 Units)
Prerequisites: CIVE 306 and admission to an engineering major within the College of Engineering and Polymer Science. Ultimate strength analysis and design; compression steel; diagonal tension; stirrups; development length; one-way slab; T-beams; two-way slabs; columns; isolated and combined footings. (Formerly 4300:403)

CIVE 404 Advanced Structural Design (3 Units)
Prerequisites: CIVE 401 and CIVE 403. Composite design; plate girders; plastic design; cantilever retaining walls; torsion in R/C members; deflection of R/C members; continuous girder bridge design. (Formerly 4300:404)

CIVE 407 Advanced Structural Analysis (3 Units)
Prerequisite: CIVE 306. Energy methods for beams and frames. Stiffness and flexibility formulations for framed structures using classical and matrix methods. Introduction to stability and plastic analysis. Warping-Torsion behavior of beams. Analysis of axisymmetric circular plates and membrane shells. (Formerly 4300:407)

CIVE 414 Design of Earth Structures (3 Units)
Prerequisite: CIVE 314 or permission. Design of earth structures: dams, highway fills, cofferdams, etc. Embankment construction techniques, quality control, embankment analysis, instrumentation, foundation soil stabilization, seepage analysis and control. Design problem. Graduate students will perform more advanced analysis and design. (Formerly 4300:414)

CIVE 418 Soil & Rock Exploration (3 Units)
Prerequisite: CIVE 314 or permission. Site exploration criteria and planning. Conventional boring, sampling and in situ testing methods. Theory and application of geophysics and geophysical methods including seismic, electrical resistivity, gravity, magnetic and radioactive measurements. Air photo interpretation. (Formerly 4300:418)

CIVE 423 Chemistry for Environmental Engineers (3 Units)
Prerequisite: One year of college chemistry. General, physical, organic biochemistry, equilibrium, and colloid chemistry concepts applied to Environmental Engineering. Concepts are used in water and wastewater laboratory. (Formerly 4300:423)

CIVE 424 Water-Wastewater Laboratory (1 Unit)
Pre/Corequisite: CIVE 323. Analysis of water and wastewater. (Formerly 4300:424)

CIVE 426 Environmental Engineering Design (3 Units)
Prerequisite: CIVE 323. An introduction to the physical, chemical and biological processes utilized in the treatment of water and wastewater, with design parameters emphasized. (Formerly 4300:426)

CIVE 427 Water Quality Modeling & Management (3 Units)
Prerequisite: CIVE 323. Analysis and simulation of the physical, chemical and biochemical processes affecting stream quality. Development of management strategies based upon the application of water quality modeling techniques to environmental systems. (Formerly 4300:427)

CIVE 428 Hazardous & Solid Wastes (3 Units)
Prerequisite: Senior standing or permission of instructor. Hazardous and solid waste quantities, properties and sources are presented. Handling, processing, storage and disposal methods are discussed with non-technical constraints outlined. (Formerly 4300:428)

CIVE 441 Hydraulic Design (3 Units)
Prerequisite: CIVE 341. Collection and critical evaluation of hydraulic data related to actual design problem selected by instructor. Development and analysis of design alternatives. Preparation of reports. (Formerly 4300:441)

CIVE 443 Applied Hydraulics (3 Units)
Prerequisites: CIVE 341 and admission to an engineering major within the College of Engineering and Polymer Science. Review of design principles: urban hydraulics, stream channel mechanics, sedimentation, coastal engineering. (Formerly 4300:443)

CIVE 445 Hydrology (3 Units)
Prerequisite: CIVE 341. Surface water hydrology, water cycle, precipitation, evaporation, stream flow. Principles of hydrologic systems and their analysis. Hydrologic simulation, reservoir planning and water supply studies. Analysis of rainfall and floods. (Formerly 4300:445)

CIVE 448 Hydraulics Laboratory (1 Unit)
Prerequisite: CIVE 341. Introduction to laboratory and field devices for hydraulic measurements. Reduction and presentation of hydraulic data. Individual assignments of model studies of hydraulic structures. (Formerly 4300:448)

CIVE 450 Urban Planning (2 Units)
Historical developments in urban planning; urban planning techniques and patterns; comprehensive master planning studies; planning regulations; design problems; class projects; class project presentation. (Formerly 4300:450)

CIVE 451 Computer Methods of Structural Analysis (3 Units)
Prerequisite: CIVE 306. Computer methods of structural analysis. Finite element software and interactive graphics. Stiffness concepts and matrix formulation of beams; modeling of simple and complex structural systems; vibration analysis using microcomputers. (Formerly 4300:451)

CIVE 452 Structural Vibrations & Earthquakes (3 Units)
Prerequisite: CIVE 306. Vibration and dynamic analysis of structural systems with one, two, or more degrees of freedom; beams, frames, buildings and bridges. Numerical methods of analysis. Elastic-plastic systems. Earthquake analysis of design. Earthquake codes. (Formerly 4300:452)

CIVE 453 Optimum Structural Design (3 Units)
Prerequisite: CIVE 306. Basic concepts in structural optimization. Mathematical programming methods including unconstrained minimization, multidimensional minimization and constrained minimization. (Formerly 4300:453)

CIVE 454 Advanced Mechanics of Materials (3 Units)
Prerequisite: CIVE 202 or equivalent. Three-dimensional state of stress and strain analysis. Unsymmetric bending of straight and curved members with shear deformation. Beams on elastic foundations. Saint Venant's torsional problems. Inelastic analysis of bending and torsional members. Introduction to energy method. Instability behavior of prismatic members. (Formerly 4300:454)

CIVE 463 Transportation Planning (3 Units)
Prerequisite: CIVE 361. Theory and techniques for development, analysis and evaluation of transportation system plans. Emphasis on understanding and using tools and professional methods available to solve transportation planning problems, especially in urban areas. (Formerly 4300:463)

CIVE 464 Highway Design (3 Units)
Prerequisite: CIVE 361. Study of modern design of geometrical and pavement features of highways. Design problem and computer use. Graduate students will produce a more complete design. (Formerly 4300:464)

CIVE 465 Pavement Engineering (3 Units)
Prerequisite: CIVE 361. Theories of elasticity, of viscoelasticity and of layered systems as applied to pavements. Pavement materials characterization; pavement design, pavement restoration for rigid and flexible pavements. (Formerly 4300:465)

CIVE 466 Traffic Engineering (3 Units)
Prerequisite: CIVE 361. Vehicle and urban travel characteristics, traffic flow theory, traffic studies, accidents and safety, traffic signs and marking, traffic signal planning, traffic control and transportation administration. (Formerly 4300:466)

CIVE 467 Advanced Highway Design (3 Units)
Prerequisites: CIVE 464, autoCAD capability, or permission. Computer-aided geometrical design of highways including survey data input, digital terrain modeling, cross-section templates, horizontal and vertical roadway design, earthwork computations, and advanced topics. (Formerly 4300:467)

CIVE 468 Highway Materials (3 Units)
Prerequisites: CIVE 361 and CIVE 380 or permission. Properties of aggregates, manufacture and properties of portland cement concrete, properties of asphaltic materials, design and testing of hot mix asphalt pavement mixes and of surface treatments. Laboratory preparation of specimens and determination of properties. Graduate student requirement: Graduate students will be required to perform an additional eight-hour asphalt laboratory (Abson recovery of asphalt from solution) and to prepare a paper on a highway materials topic. (Formerly 4300:468)

CIVE 471 Construction Administration (3 Units)
Prerequisites: Junior standing and full admission to an engineering major in the College of Engineering and Polymer Science. Construction management functions, scheduling techniques for construction projects, scheduling PERT networks and linear operations, estimating building projects, construction contracts and legal structure, construction finance, engineering economics, equipment productivity, machine power, equipment selection and utilization, equipment cost, construction safety, construction trends, LEED construction. (Formerly 4300:471)

CIVE 472 Construction Engineering (3 Units)
Prerequisite: Senior standing or permission. Construction equipment selection and management. Techniques of various engineering construction operations including blasting, tunneling, concrete framework and dewatering. (Formerly 4300:472)

CIVE 473 Construction Materials (2 Units)
Prerequisites: CIVE 380 and CHEE 305. Composition, structure and mechanical behavior of structural materials such as concrete, wood, masonry, plastics and composite materials. Discussion of applications and principles of evaluating material properties. (Formerly 4300:473)

CIVE 474 Underground Construction (2 Units)
Prerequisite: CIVE 314. Description of practices and techniques of underground construction. Selection of proper method for individual job. Design of underground openings, support systems and linings. (Formerly 4300:474)

CIVE 480 Reliability-Based Design (4 Units)
Prerequisite: STAT 261 and senior standing. Probability concepts in civil engineering. Risk analysis and reliability based design. (Formerly 4300:480)

CIVE 482 Special Projects: Civil Engineering (1-3 Units)
Prerequisites: Senior standing and permission. Directed individual or group research or study in student's field of interest. Topic subject to approval by adviser. (Formerly 4300:482)

CIVE 489 Fundamental of Engineering Exam Review (0 Units)
Prerequisite: Senior standing. This course is intended to prepare civil engineering students for the Fundamentals of Engineering Exam, which is to be taken prior to graduation. (Formerly 4300:489)

CIVE 490 Senior Design in Civil Engineering (3 Units)
Prerequisites: CIVE 323, CIVE 341, CIVE 361, CIVE 403, senior standing and admission to an engineering major within the College of Engineering and Polymer Science. Pre/Corequisites: CIVE 314 and CIVE 401. A civil engineering design project that emphasizes interdisciplinary teamwork to solve a substantial, currently relevant problem. (Formerly 4300:490)
Gen Ed: Capstone

CIVE 497 Honors Project (1-3 Units)
(May be repeated for a total of six credits) Prerequisite: Senior standing in Honors Program. Individual creative project or design relevant to civil engineering, supervised by faculty member of the department. (Formerly 4300:497)