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 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.

### 4300: Civil Engineering

Civil Engineers plan, design, build, and operate the infrastructure of modern society. This includes highways, bridges, buildings, power plants, industrial facilities, tunnels, seaports, airports, offshore structures and almost anything else needed as the basis of modern life. Civil engineers are also vigorously engaged in environmental activities, particularly creating safe water supplies and transporting it to where it is needed, collecting and treating wastewaters, cleanup of environmental problems, and insuring the safe disposal of solid wastes.

To achieve the high level of professional competence needed, an extensive study of mathematics, mechanics (both solids and fluids), engineering materials, structural design and environmental reactions is required. The civil engineering sub-topics that utilize these fundamentals are environmental, geotechnical, hydraulic, structural, and transportation engineering. The civil engineering curriculum at The University of Akron insures a firm grounding in all these sub-topic areas, while allowing a specialization, if desired, in the environmental, geotechnical, transportation, and structural areas. Engineering design problems are incorporated into courses in each area. The senior capstone design course presents a problem involving one, or possibly all, of these areas in the design of complex systems.

Most civil engineering graduates work for design consultants, construction companies, or governmental agencies. Others work for industrial firms and utilities. Many civil engineers own their own businesses.

The Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org). The program educational objectives (PEOs) for the Civil Engineering program are that, within a few years after graduation, our Civil Engineering graduates:

- successfully and accurately complete Civil Engineering projects as part of a team, on time and within budget, in an ethical and professional manner, and using modern engineering tools-software
- an ability to communicate effectively with written, oral, and visual means in both technical and non-technical settings
- professional service as evidenced by participation in a professional society and/or educational outreach activities
- engage in lifelong learning as evidenced by participation in continuing education courses, workshops, graduate courses, and by pursuing professional licensure
- a basic knowledge of the business of engineering including how the private and public sector operate separately and collectively

The curriculum is designed to emphasize the fundamentals which place the graduate in a strong position to pursue further education, formally or informally, and to begin a career in any of the above areas. To meet the curriculum requirements specified by the American Society of Civil Engineers (ASCE), the civil engineering program will prepare students to meet the following student outcomes at the time of graduation:

#### Foundational

- Solve problems in mathematics through differential equations and apply this knowledge to the solution of engineering problems
- Solve problems in calculus-based physics, chemistry, and one additional area of natural science and apply this knowledge to the solution of engineering problems
- Demonstrate the importance of the humanities in the professional practice of engineering
- Demonstrate the incorporation of social sciences knowledge into the professional practice of engineering

#### Technical

- Use knowledge of materials science to solve problems appropriate to civil engineering
- Analyze and solve problems in solid and fluid mechanics
- Specify an experiment to meet a need, conduct the experiment, and analyze and explain the resulting data
- Formulate and solve an ill-defined engineering problem appropriate to civil engineering by selecting and applying appropriate techniques and tools
- Evaluate the design of a complex system, component, or process and assess compliance with customary standards of practice, user's and project's needs, and relevant constraints
- Analyze systems of engineered works, whether traditional or emergent, for sustainable performance
- Analyze the impact of historical and contemporary issues on the identification, formulation, and solution of engineering problems and analyze the impact of engineering solutions on the economy, environment, political landscape, and society
- Analyze the loading and capacity, and the effects of their respective uncertainties, for a well-defined design and illustrate the underlying probability of failure (or nonperformance) for a specified failure mode
- Formulate documents to be incorporated into the project plan
- Analyze and solve well-defined engineering problems in at least four technical areas appropriate to civil engineering
- Evaluate the design of a complex system or process, or evaluate the validity of newly created knowledge or technologies in a traditional or emerging advanced specialized technical area appropriate to civil engineering

#### Professional

- Plan, compose, and integrate the verbal, written, virtual, and graphical communication of a project to technical and non-technical audiences
- Apply public policy process techniques to simple public policy problems related to civil engineering works
- Apply business and public administration concepts and processes
- Analyze engineering works and services in order to function at a basic level in a global context
- Organize and direct the efforts of a group
- Function effectively as a member of a multidisciplinary team
- Demonstrate attitudes supportive of the professional practice of civil engineering
- Plan and execute the acquisition of required expertise appropriate for professional practice
• Justify a solution to an engineering problem based on professional and ethical standards and assess personal professional and ethical development.

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

• Civil Engineering, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering/civil-engineering/civil-engineering-bs)
• Civil Engineering, Co-op Option, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering/civil-engineering/civil-engineering-co-op-bs)

Civil Engineering (4300)

4300:101 Tools for Civil Engineering I (3 Credits)
Corequisite: 3450:149 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.

4300:102 Tools for Civil Engineering II (3 Credits)
Prerequisite: 4300:101. 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.

4300:201 Statics (3 Credits)
Corequisites: 3450:222 and 3650:291. Forces, resultants, couples; equilibrium of force systems; distributed forces; centers of gravity; analysis of simple structures; moments of inertia; kinematics.

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

4300:306 Theory of Structures (3 Credits)
Prerequisite: 4300:202 and admission to the College of Engineering. 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.

4300:313 Soil Mechanics (3 Credits)
Prerequisite: 4300:202 and admission to the College of Engineering or permission. Physical properties of soils. Soil water and groundwater flow. Stresses, displacements, volume changes, consolidation within a soil mass. Soil strength. Compaction.

4300:314 Geotechnical Engineering (3 Credits)
Prerequisites: 4300:313 and admission to the College of Engineering. Limiting equilibrium within a soil mass. Design of retaining walls, bulkheads, shallow, deep foundation systems. Slope stability. Laboratory study of soil properties and behavior.

4300:321 Introduction to Environmental Engineering (3 Credits)
Prerequisites: 3150:153 and 3450:222. Basic principles of ecosystems, microbiology, chemical reactions, and material flow that environmental engineers use to protect our water, air and soil.

4300:323 Water Supply & Pollution Control (3 Credits)
Prerequisite: 4300:321 and admission to the College of Engineering. Water and wastewater characteristics, criteria, quantities and distribution. Water and wastewater treatment process flowsheets, design and operation. Wastewater and residue disposal.

4300:341 Hydraulic Engineering (3 Credits)
Prerequisites: 4600:310 and admission to the College of Engineering. 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.

4300:361 Transportation Engineering (3 Credits)
Prerequisites: junior standing and admission to the College of Engineering. Introductory survey of transportation topics including transportation planning requirements and techniques, introduction to design of highways, airports and railroads and introduction to traffic engineering.

4300:380 Engineering Materials Laboratory (3 Credits)
Prerequisites: 4300:202 and admission to the College of Engineering. Fundamentals and applications of materials science, mechanics of solids and study of laboratory instrumentation and standard techniques in testing of engineering materials.

4300:401 Steel Design (3 Credits)
Prerequisites: 4300:306 and admission to the College of Engineering. Tension, compression members; open web joists; beams; bearing plates; beam-columns; bolted, welded connections.

4300:403 Reinforced Concrete Design (3 Credits)
Prerequisites: 4300:306 and admission to the College of Engineering. 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.

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

4300:407 Advanced Structural Analysis (3 Credits)

4300:414 Design of Earth Structures (3 Credits)
Prerequisite: 4300:314 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.

4300:418 Soil & Rock Exploration (3 Credits)
Prerequisite: 4300:314 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.
4300:423 Chemistry for Environmental Engineers (3 Credits)
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.

4300:424 Water-Wastewater Laboratory (1 Credit)
Corequisite: 4300:323 or permission. Analysis of water and wastewater.

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

4300:427 Water Quality Modeling & Management (3 Credits)
Prerequisite: 4300:323. 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.

4300:428 Hazardous & Solid Wastes (3 Credits)
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.

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

4300:443 Applied Hydraulics (3 Credits)
Prerequisites: 4300:341 and admission to the College of Engineering. Review of design principles: urban hydraulics, stream channel mechanics, sedimentation, coastal engineering.

4300:445 Hydrology (3 Credits)

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

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

4300:451 Computer Methods of Structural Analysis (3 Credits)

4300:452 Structural Vibrations & Earthquakes (3 Credits)

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

4300:454 Advanced Mechanics of Materials (3 Credits)

4300:463 Transportation Planning (3 Credits)
Prerequisite: 4300:361. 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.

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

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

4300:466 Traffic Engineering (3 Credits)
Prerequisite: 4300:361. 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.

4300:467 Advanced Highway Design (3 Credits)
Prerequisites: 4300:464, 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.

4300:468 Highway Materials (3 Credits)
Prerequisites: 4300:361 and 4300:380 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.

4300:471 Construction Administration (3 Credits)
Prerequisites: senior standing and admission to the College of Engineering or permission. Organization for construction, construction contracts, estimating, bidding, bonds and insurance. Construction financial management and supervision of construction, scheduling using critical path method.

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

4300:473 Construction Materials (2 Credits)
Prerequisites: 4300:380, 4200:305. 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.
4300:474 Underground Construction (2 Credits)
Prerequisite: 4300:314. Description of practices and techniques of underground construction. Selection of proper method for individual job. Design of underground openings, support systems and linings.

4300:480 Reliability-Based Design (4 Credits)
Prerequisite: 3470:261 and senior standing. Probability concepts in civil engineering. Risk analysis and reliability based design.

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

4300:490 Senior Design in Civil Engineering (3 Credits)
Prerequisites: senior standing and admission to the College of Engineering. A civil engineering design project that emphasizes interdisciplinary teamwork to solve a substantial, currently relevant problem.
Gen Ed: Tier 3 - Complex Systems

4300:497 Honors Project (1-3 Credits)
(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.