DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Bachelor of Science Degree in Civil Engineering

The Department of Civil and Environmental Engineering offers an ABET-accredited bachelor’s program that, in terms of graduating class size, ranks in the 80th percentile nation-wide. The Department is committed to providing a learning environment which encourages discovery and advancement for the betterment of its students and the community. Through its research, public service, and instructional programs, the Department seeks to serve the needs of San Antonio and South Texas by providing educational and research opportunities contributing to the technological and economic development of the region.

Civil Engineering Educational Objectives

The American Society of Civil Engineers (ASCE) defines Civil Engineering as “The profession in which a knowledge of the mathematical and physical sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the progressive well-being of humanity in creating, improving, and protecting the environment; in providing facilities for community living, industry, and transportation; and in providing structures for the use of humanity.”

The faculty of the Department of Civil and Environmental Engineering has established a specific set of program objectives to support the mission and the goals of the Department and to meet the requirements of ABET accreditation under the Criteria for Accrediting Engineering Programs (2009). The educational objectives of the Civil Engineering undergraduate program are to produce Bachelor of Science graduates who:

• meet the expectations of their employers,
• will endeavor to become licensed professional engineers, and
• are able to pursue graduate studies, if so desired.

Civil Engineering students must first complete the University Core Curriculum requirements and the Department’s General Engineering requirements. The University Core Curriculum requirements consist of 42 semester credit hours and provide the scientific foundation required for advancing successfully to the General Engineering requirement courses. They include courses in Communications, Mathematics, Natural Sciences, Social and Behavioral Sciences, Humanities and World Issues.

The General Engineering requirements consist of 25 semester credit hours geared toward advancing the technical abilities and skills necessary to meet the educational objectives of the College of Engineering. They include a number of the Core Curriculum required courses, namely MAT 1214 Calculus I, CHE 1103 General Chemistry I, PHY 1903 Engineering Physics I, and PHY 1911 Engineering Physics I Laboratory. Students are also encouraged to take ECO 2013 Introductory Macroeconomics or ECO 2023 Introductory Microeconomics. In addition, General Engineering requirements include MAT 1224 Calculus II, PHY 1923 Engineering Physics II, PHY 1931 Engineering Physics II Laboratory, EGR 2323 Applied Engineering Analysis I, and EGR 3713 Engineering Economic Analysis.

Subsequently, students need to take 70 additional semester credit hours of Civil Engineering courses. Courses for 64 of these credit hours are required, while the remaining 6 credit hours can be selected from among CE elective courses. The elective courses allow some specialization in one of the traditional Civil Engineering areas, namely, Environmental Geotechnical, Hydraulics, Structures and Transportation. Senior Civil Engineering students, in their last semester of study, are required to take the Fundamentals of Engineering (FE) Examination as administered by the National Council of Examiners for Engineering and Surveying (www.ncees.org). Graduates are encouraged to further pursue life-long learning and obtain their Professional Engineering license.

Design is integrated throughout the curriculum starting with a freshman introductory course, CE 1301 Introduction to Civil Engineering, and ending with the senior capstone Civil Engineering Design course CE 4813. Design components are contained in most required engineering topics courses. These include CE 3213 Reinforced Concrete Design, CE 3233 Steel Design, CE 3413 Geotechnical Engineering and Applications, CE 3633 Water and Wastewater Treatment, CE 4123 Highway Engineering, and CE 4603 Water Resources Engineering. Design is also included in many of the technical elective courses.
The design experience culminates in the senior capstone design course, CE 4813 Civil Engineering Design. The capstone design project is multidisciplinary in that it involves three or more civil engineering areas and draws upon most prior coursework. The course involves teamwork, both oral and written presentations, a final design report, and a formal presentation.

The minimum number of semester credit hours required for this degree is 128, including at least 39 at the upper-division level. All candidates for this degree must fulfill the Core Curriculum requirements, the General Engineering requirements, and the Civil Engineering degree requirements prior to graduation.

**Core Curriculum requirements**: The Core Curriculum requirements are listed below. Students are to select courses to satisfy the required number of credit hours in each of the component areas to a total minimum of 42 credit hours. A more detailed listing of these courses can be found on pages 5–9 of this catalog. It should be noted that a number of courses identified on this table satisfy both the Core Curriculum and the General Engineering requirements.

<table>
<thead>
<tr>
<th>Core Curriculum Component Area</th>
<th>Courses that Satisfy Core Curriculum and Degree Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communications</strong></td>
<td><strong>English Rhetoric/Composition</strong> (6 semester credit hours)</td>
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<tr>
<td></td>
<td>All students must take the following six hours to meet this core requirement:</td>
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<td></td>
<td>WRC 1013 Freshman Composition I</td>
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<td></td>
<td>WRC 1023 Freshman Composition II</td>
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<tr>
<td><strong>Mathematics</strong></td>
<td><strong>Mathematics</strong> (3 semester credit hours)</td>
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<td></td>
<td>Any three hours listed under this section in the list of core courses will satisfy this core requirement.</td>
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<tr>
<td></td>
<td>Note: MAT 1214 Calculus I may be used to satisfy the Core Curriculum requirement for mathematics, as well as one of the General Engineering requirements to a maximum of 3 credit hours.</td>
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<tr>
<td><strong>Natural Sciences</strong></td>
<td><strong>Science</strong> (6 semester credit hours)</td>
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<td></td>
<td>Three hours from Level One and three hours from Level Two will satisfy this core requirement.</td>
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<tr>
<td></td>
<td>Note: CHE 1103 General Chemistry I and PHY 1903 Engineering Physics I may be used to satisfy the Core Curriculum requirements for science, as well as two of the General Engineering requirements to a maximum of 6 credit hours.</td>
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<tr>
<td><strong>Humanities &amp; Visual and Performing Arts</strong></td>
<td><strong>Literature</strong> (3 semester credit hours)</td>
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<td>Any three hours listed under this section in the list of core courses will satisfy this core requirement.</td>
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<td></td>
<td><strong>The Arts</strong> (3 semester credit hours)</td>
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<td>Any three hours listed under this section in the list of core courses will satisfy this core requirement.</td>
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<tr>
<td><strong>Social and Behavioral Sciences</strong></td>
<td><strong>United States History and Diversity</strong> (6 semester credit hours)</td>
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<td>Any six hours listed under this section in the list of core courses will satisfy this core requirement.</td>
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<td></td>
<td><strong>Political Science</strong> (6 semester credit hours)</td>
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<td></td>
<td>POL 1013 Introduction to American Politics, plus three additional hours listed under this section in the list of core courses will satisfy this core requirement.</td>
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<tr>
<td></td>
<td><strong>Social and Behavioral Science</strong> (3 semester credit hours)</td>
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<td></td>
<td>COR 1203 Freshman Seminar</td>
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<td></td>
<td><strong>Economics</strong> (3 semester credit hours)</td>
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<td>One of the following courses is recommended to satisfy this core requirement:</td>
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<td></td>
<td>ECO 2013 Introductory Macroeconomics</td>
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<tr>
<td></td>
<td>ECO 2023 Introductory Microeconomics</td>
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</tbody>
</table>
Core Curriculum Component Area | Courses that Satisfy Core Curriculum and Degree Requirements
---|---
World Society and Issues | (3 semester credit hours)
Any three hours listed under this section in the list of core courses will satisfy this core requirement.

**General Engineering Requirements**

In addition to the Core Curriculum requirements, all degree-seeking Civil Engineering students must complete the following 25 semester credit hours:

- CHE 1103 General Chemistry I
- EGR 2323 Applied Engineering Analysis I
- EGR 3713 Engineering Economic Analysis
- MAT 1214 Calculus I
- MAT 1224 Calculus II
- PHY 1903, 1911 Engineering Physics I and Laboratory
- PHY 1923, 1931 Engineering Physics II and Laboratory

**Civil Engineering Degree Requirements**

In addition to the Core Curriculum and the General Engineering requirements described above, all degree-seeking candidates in Civil Engineering must complete the following 70 semester credit hours:

A. 64 semester credit hours of required courses:

- CE 1301 Introduction to Civil Engineering
- CE 1403 Engineering Communication
- CE 2103 Civil Engineering Measurements
- CE 2633 Environmental Engineering
- CE 3103 Mechanics of Solids
- CE 3113 Structural Analysis
- CE 3173 Numerical Methods
- CE 3213 Reinforced Concrete Design
- CE 3233 Steel Design
- CE 3243 Properties and Behavior of Engineering Materials
- CE 3413 Geotechnical Engineering and Applications
- CE 3543 Project Design and Construction Management
- CE 3603 Fluid Mechanics
- CE 3633 Water and Wastewater Treatment
- CE 4123 Highway Engineering
- CE 4313 Computer-Aided Design in Civil Engineering
- CE 4603 Water Resources Engineering
- CE 4813 Civil Engineering Design
- EGR 2103 Statics
- EGR 2513 Dynamics
- GEO 4023 Engineering Geology
- STA 2303 Applied Probability and Statistics for Engineers

B. 6 semester credit hours of Civil Engineering technical electives must be selected from the list below. Alternatively, students with a grade point average of 3.0 or higher may choose to satisfy this requirement by taking graduate courses offered by the Department of Civil and Environmental Engineering.

- CE 3253 Introduction to Masonry and Timber Design
- CE 3723 Applied Hydrology
COURSE DESCRIPTIONS
CIVIL ENGINEERING
(CE)

1301 Introduction to Civil Engineering
(1-0) 1 hour credit.
Engineering as a career, engineering ethics, and approaches to engineering problem formulation and solution using principles of design and decision making.

1403 Engineering Communication
(2-3) 3 hours credit.
Technical communication: oral, written, and graphic; introduction to engineering analysis, design, and synthesis; and computer-aided graphics.

2103 Civil Engineering Measurements
(2-3) 3 hours credit. Corequisites: MAT 1214 and CE 1301.
Principles of measurement and error analysis; application of equipment to acquire, analyze, and control data in civil engineering systems; and introduction to plane surveying.

2633 Environmental Engineering
(3-0) 3 hours credit. Prerequisites: CE 1301 and CHE 1103.
Principles, analysis, and design related to environmental monitoring, protection, and remediation systems. Topics include environmental quality and legislation, modeling, water treatment, wastewater treatment, solid and hazardous waste management, air and noise pollution, and radioactive waste management.

3103 Mechanics of Solids
(2-3) 3 hours credit. Prerequisites: EGR 2103 and EGR 2323.
Internal forces and deformations in solids; stress, strain, and their relations; stresses and deflections in beams column theory and analysis; and engineering applications.

3113 Structural Analysis
(3-0) 3 hours credit. Prerequisite: CE 3103.
Forces and deflections in structural systems; considers stationary and moving loads and exact and approximate methods.

3173 Numerical Methods
(3-0) 3 hours credit. Prerequisite: EGR 2323.
An introduction to numerical and analytical methods applied to civil and environmental engineering. Techniques for computer solution of linear and nonlinear simultaneous equations; eigenvalue analysis; finite differences; numerical integration; numerical solutions to ordinary differential equations. Introduction to Visual Basic in Excel applications. Case studies in the various branches of civil engineering.
3213  **Reinforced Concrete Design**  
(2-3) 3 hours credit. Prerequisites or concurrent enrollment: CE 3113 and CE 3243.  
Ultimate strength theory and design for reinforced concrete members.

3233  **Steel Design**  
(2-3) 3 hours credit. Prerequisites or concurrent enrollment: CE 3113 and CE 3243.  
Analysis and design of steel tension members, beams, columns, and bolted or welded connections.

3243  **Properties and Behavior of Engineering Materials**  
(2-3) 3 hours credit. Prerequisites: CE 3103 and STA 2303.  
Structure, properties, and behavior of engineering materials; measurement and analysis of material properties and behavior. Laboratory exercises illustrate typical material behavior and selected principles of mechanics.

3253  **Introduction to Masonry and Timber Design**  
(3-0) 3 hours credit. Prerequisites or concurrent enrollment: CE 3113 and CE 3243.  
Technical elective course. Design philosophy and methodology for masonry and timber structures. Flexure design, axial load design, and shear design of basic masonry and timber components.

3413  **Geotechnical Engineering and Applications**  
(2-3) 3 hours credit. Prerequisite: CE 3103. Corequisites: CE 3173 and GEO 4023.  
Exploration, sampling, and in-situ measurements; laboratory testing; review of fundamental properties of soil and rock; flow-through porous media; the effective stress principle and computation of in-situ stress distributions; shear strength of soils and one-dimensional consolidation settlement; introduction to slope stability.

3543  **Project Design and Construction Management**  
(3-0) 3 hours credit. Prerequisites: CE 2103, CE 3213, CE 3233, and EGR 3713.  
Civil Engineering design process, project specifications, and construction management. Topics covered include design process/practices, project proposals, pricing, specifications, bidding strategies, project management/scheduling and project financing. In addition, all students registered for this course are required to take a commercially offered practice FE (Fundamentals of Engineering) exam, such as the one offered by Professional Publications, Inc. or equivalent, as instructed by the Department. The fee for the exam is covered by the course fee and it is paid by UTSA. The grade received in the practice FE exam is worth 10% of the course grade. The course concludes by forming the student teams for CE 4813 Civil Engineering Design and identifying their projects. Course must be taken the semester prior to taking CE 4813.

3603  **Fluid Mechanics**  
(2-3) 3 hours credit. Prerequisites: EGR 2103 and EGR 2513.  
Fluid properties, fluid statics concepts, equations of fluid flow in pipes and open channels, and flow-through porous media.

3633  **Water and Wastewater Treatment**  
(2-3) 3 hours credit. Prerequisites: CE 2633 and CE 3603.  
The application of chemical, biochemical, and physical processes to water treatment, wastewater treatment, and pollution control.

3723  **Applied Hydrology**  
(3-0) 3 hours credit. Prerequisite: CE 3603.  
Technical elective course. Hydrologic cycle, precipitation, hydrologic abstractions, surface runoff; unit hydrographs; synthetic hydrographs; peak discharge relationships; flood frequency analysis; flood and reservoir routing; and groundwater hydrology.
4013  Civil Engineering Systems Analysis  
(3-0) 3 hours credit. Prerequisite: EGR 3713.  
Technical elective course. Systems approach to optimization and problem solving; operations research applications in civil engineering; mathematical modeling and analysis techniques including linear programming, dynamic programming, decision analysis and use of software to solve linear and nonlinear programming problems. (Formerly CE 3713. Credit cannot be earned for both CE 4013 and CE 3713.)

4103  Advanced Steel Design  
(3-0) 3 hours credit. Prerequisite: CE 3233.  
Technical elective course. Connection design, welded and bolted, moment-resistant connections, plate girders, column stability, bracing design, and seismic design of frames.

4123  Highway Engineering  
(3-0) 3 hours credit. Prerequisites: CE 2103, CE 3413, and STA 2303.  
General characteristics of highway design; horizontal and vertical alignment, cross-sections, earthwork, drainage, and pavement; and economic analysis.

4133  Advanced Reinforced Concrete  
(3-0) 3 hours credit. Prerequisite: CE 3213.  
Technical elective course. Torsion design, design of stairs, bending of curved elements, biaxial loads on columns, slenderness effects, joint design, yield line theory, two-way slab systems, strut-and-tie methods, seismic detailing, relationship between research and building code.

4153  Prestressed Concrete  
(3-0) 3 hours credit. Prerequisite: CE 3213.  
Technical elective course. Design of statically determinate and indeterminate structures, estimation of prestress loss, flexure and shear strength, deflections and stress control, composite construction, and continuous span theory.

4293  Geographic Information Systems (GIS)  
(3-0) 3 hours credit. Prerequisite: CE 2103 or GEO 4023.  
Technical elective course. Introduces vector, raster and tabular concepts, emphasizing the vector approach. Topics include: spatial relationships, map features, attributes, relational database, layers of data, data ingesting, digitizing from maps, projections, output, applications, and availability of public data sets. Focus will be placed on spatial/temporal data analyses using digitized maps and database information in an area of Civil Engineering specialization.

4303  Hydrometeorology  
(3-0) 3 hours credit. Prerequisite: CE 3603.  
Technical elective course. The main objective of this course is to familiarize the student with topics related to local and global distribution of freshwater. Conceptualizations of the water balance/budget are developed using principles of physical hydrology and meteorology. Emphasis will be on recent research and modern methods for data analysis and modeling. Real-life events and phenomena will be discussed. In addition to the text, material will be presented from other sources. Guest instructors will give presentations on some case studies.

4313  Computer-Aided Design in Civil Engineering  
(2-3) 3 hours credit. Prerequisites: CE 1403, CE 2103, and CE 3603.  
Organization and programming of civil engineering problems for computer solutions; application of computer-aided design in civil engineering.

4403  Advanced Characterization of Highway Materials  
(3-0) 3 hours credit. Prerequisite: CE 3243.  
Technical elective course. Basic and advanced level of the fundamentals of material response to static and repeated loading; emphasis on the deformation and fatigue behavior of asphalt mixtures, constitutive modeling for mixtures, microstructure characterization for mixtures, nondestructive testing of pavements, asphalt binder characterization, unbound materials (base and sub-base materials) evaluation and characterization.
4453  Transportation Engineering
(3-0) 3 hours credit. Prerequisite: CE 4123.
Technical elective course. Study of the Highway Capacity Manual, traffic stream parameters and relationships, analytical techniques in traffic engineering such as capacity analysis, queuing theory, and traffic simulation. Design and operation of advanced traffic management systems including signalization, real-time motorist information, urban incident management, and ITS concepts. (Formerly CE 4233. Credit cannot be earned for both CE 4453 and CE 4233.)

4463  Foundation Engineering
(3-0) 3 hours credit. Prerequisite: CE 3413.
Technical elective course. Shallow and deep foundations including: footings, slabs on-grade, cofferdams, sheet-pile walls, drilled shafts, piles and retaining walls. (Formerly CE 4413. Credit cannot be earned for both CE 4463 and CE 4413.)

4603  Water Resources Engineering
(3-0) 3 hours credit. Prerequisites: CE 2633 and CE 3603. Corequisite: CE 3633.
Analysis and design of surface and subsurface water resource facilities. Design of water supply, wastewater collection, and storm water systems.

4613  Environmental Chemistry
(3-0) 3 hours credit. Prerequisite: CE 3633.
Technical elective course. This course explores the chemistry of the environment, the chemistry underlying environmental problems and solutions to environmental problems. Emphasis is placed on thermodynamics and kinetics of reaction cycles; sources, sinks and transport of chemical species; and quantitation of chemical species. Examples are selected from the chemistry of natural and contaminated air, water, and soil.

4723  Hydraulic Systems Design
(3-0) 3 hours credit. Prerequisite: CE 4603.
Technical elective course. Analysis and design of water resource systems; dam and reservoir design for recharge, flood control, and water supply and demand forecasting, optimization of multi-objective systems, and allocations planning and management.

4813  Civil Engineering Design
(2-3) 3 hours credit. Prerequisites: CE 3213, CE 3233, and CE 3543.
Opportunity to apply design skills to execution of an open-ended integrated civil engineering design project, including field and laboratory investigations, numerical and scale modeling, design, and formal oral and written presentation of results. Considers safety, reliability, environmental, economic, and other constraints, as well as ethical and social impacts. Students must take the FE (Fundamentals of Engineering) exam during the semester they take this course.

4911-3  Independent Study
1 to 3 hours credit. Prerequisites: Permission in writing (form available) from the instructor, the student’s advisor, the Department Chair and Dean of the College.
Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor’s degree.

4953  Special Studies in Civil Engineering
(3-0) 3 hours credit. Prerequisite: Consent of instructor.
An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree.