

# Civil Engineering (CE)

B.S. in Civil Engineering (<https://catalog.und.edu/undergraduateacademicinformation/departmentalcoursesprograms/civilengineering/cive-bs/>)

Four Year Plan - B.S. in Civil Engineering (p. 1)

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### Freshman Year

Fall		Credits
CE 101	Introduction to Civil Engineering	1
CHEM 121 & 121L	General Chemistry I and General Chemistry I Laboratory ***	4
ENGL 110	College Composition I ***	3
MATH 165	Calculus I ***	4
Essential Studies		3
<b>Credits</b>		<b>15</b>

Spring		Credits
CE 103	Graphical Communication ***	3
ENGL 130	Composition II: Writing for Public Audiences ***	3
ENGR 200	Computer Applications in Engineering †	2
MATH 166	Calculus II ***	4
Essential Studies		3
<b>Credits</b>		<b>15</b>

### Sophomore Year

Fall		Credits
CE 313	General Surveying	2
CE 313L	General Surveying Laboratory ‡	1
ENGR 201	Statics ***	3
GEOE 203 or GEOL 101	Earth Dynamics Lab optional* or Introduction to Geology	3
MATH 265	Calculus III ***	4
PHYS 251	University Physics I ***	4
<b>Credits</b>		<b>17</b>

Spring		Credits
ENGR 202	Dynamics †	3
ENGR 203	Mechanics of Materials ***	3
MATH 266	Elementary Differential Equations	3
PHYS 252	University Physics II	4
or CHEM 122 and CHEM 122L or BIOL 150 and BIOL 150L	or General Chemistry II and General Chemistry II Laboratory or General Biology I and General Biology I Laboratory	
MATH 321 or CHE 315 or ECON 210	Applied Statistical Methods ** or Engineering Statistics and Design of Experiments or Introduction to Business and Economic Statistics	3
<b>Credits</b>		<b>16</b>

### Junior Year

Fall		Credits
CE 306	Fluid Mechanics	3
CE 351	Structural Mechanics	4
CE 411	Civil Engineering Materials Laboratory ‡	1
CE 412	Soil Mechanics	3
CE 412L	Soil Mechanics Lab ‡	1
ENGR 340	Professional Integrity in Engineering	3
<b>Credits</b>		<b>15</b>

### Spring

CE 423	Hydraulic Engineering	3
CE 423L	Hydraulic Engineering Laboratory ‡	1
CE 431	Environmental Engineering I	3
CE 431L	Environmental Engineering Laboratory ‡	1
CE 451	Steel Design	3
Technical Elective		3
Essential Studies		3
<b>Credits</b>		<b>17</b>

### Senior Year

Fall		Credits
CE 421	Hydrology	3
CE 432	Environmental Engineering II	3
CE 453	Reinforced Concrete	3
CE 482	Civil Engineering Design I	3
ENGR 460	Engineering Economy	3
Essential Studies		3
<b>Credits</b>		<b>18</b>

Spring		Credits
CE 414	Foundation Engineering	3
CE 416	Transportation Engineering	3
CE 444	Contracts and Specifications	3
CE 483	Civil Engineering Design II	3
Technical Elective		3
<b>Credits</b>		<b>15</b>
<b>Total Credits</b>		<b>128</b>

\* Students are encouraged to take GEOE 203 Earth Dynamics.

\*\* Students can take MATH 321 or CHE 315 or ECON 210 as a statistics course. If students take MATH 321 Applied Statistical Methods as their statistics elective and MATH 421 Statistical Theory I as their technical elective, they will earn a minor in Math, without adding extra courses to their degree plan.

\*\*\* UND Civil Engineering Degree Program requires courses as well as ENGL 110 College Composition I and ENGL 130 Composition II: Writing for Public Audiences to be completed with at least a "C" grade in each of the courses.

† Either ENGR 200 Computer Applications in Engineering OR ENGR 202 Dynamics must be completed with a "C" or higher. \*\*\*\*Students must ensure all appropriate pre-requisites are met prior to registering for all courses in the curriculum.

‡ Labs must be completed on campus, through CE 102 Professional Assessment and Evaluation or from a pre-approved transfer institution. For more information on labs, please visit here (<https://engineering.und.edu/current-students/summer-lab-req.html>).

Students must ensure all appropriate pre-requisites are met prior to registering for all courses in the curriculum.

Students have the opportunity to take CE 102 Professional Assessment and Evaluation where they can petition to waive a program specific requirement, not university or essential studies requirements, for the following courses: CE 101, CE 103, CE 313, CE 313L, CE 397(up to 3 crs), CE 411, CE 412L, CE 423L, CE 431L, CE 444, ENGR 200, ENGR 340.

All engineering, science, and math transfer courses must earn a grade of "C" or higher to be applied to the program.

Students must complete a minimum of 21 credit hours of 300-level or higher coursework in Civil Engineering at UND, including CE 482 Civil Engineering Design I and CE 483 Civil Engineering Design II.

All Civil Engineering students must take at least one technical elective in Civil Engineering from UND except those who transfer both technical elective requirements.

A minimum CGPA of 2.00 in Engineering is required to graduate.

Please Note: Every student must fulfill all University and Departmental requirements to graduate.

#### **CE 101. Introduction to Civil Engineering. 1 Credit.**

Course will be a series of lectures, discussions and group projects, concerning the practice of civil engineering and sustainable design. Topics include scope of civil engineering practice, professional ethics, professional practice issues, sustainable engineering design concepts, communication skills, project management and team-working, literature searches and information gathering, and career planning. Exposure to Grand Challenges. Prerequisite: CE major or department permission. S/U grading. F.

#### **CE 102. Professional Assessment and Evaluation. 1 Credit.**

This course is designed for students with industrial experience. Students complete a portfolio documenting educational and work experiences for evaluation, and individualized curriculum plans are developed. Based on the assessment and evaluation, some civil engineering requirements may be waived. Prerequisite: Work experience and/or technical school training plus completion of CHEM 121, CHEM 121L, PHYS 251, and MATH 265. S/U grading. F,S,SS.

#### **CE 103. Graphical Communication. 3 Credits.**

Development of visualization, technical communication, and documentation skills. The course covers 3D AutoCAD geometric modeling using current methods and techniques commonly found in the industry and Civil 3D land systems design program. Fundamentals of land surface modeling and current surveying techniques will be taught in a combined lecture-laboratory format. On-campus students have access to necessary software programs through the CEM computer system. DEDP students are required to download a free computer aided design software version from AUTODESK to their personal computer. Prerequisite: CE major and CE 101 or permission of department.

#### **CE 306. Fluid Mechanics. 3 Credits.**

Fluid properties; fluid statics and dynamics; transport theory and transport analogies, conservation of mass, energy, and momentum; dimensional analysis; boundary layer concepts; pipe flows; compressible flow; open channel flow. Prerequisite: PHYS 251 and MATH 265. F,S.

#### **CE 313. General Surveying. 2 Credits.**

Measurements of distances and angles, EDM, satellite and inertial systems, triangulation, differential leveling, horizontal curves, vertical curves, traverse surveys, U.S. public land surveys, earthwork, boundary surveys and construction surveys. Basic knowledge of geometry and trigonometry required. Prerequisite: MATH 165 and CE 101 or permission of the department. Corequisite: On campus students must take CE 313L along with this class. F.

#### **CE 313C. General Surveying. 2 Credits.**

Measurements of distances and angles; EDM; satellite and inertial systems; triangulation; differential leveling; horizontal curves; vertical curves; traverse surveys; U.S. public land surveys; earthwork; boundary surveys; construction surveys. F.

#### **CE 313L. General Surveying Laboratory. 1 Credit.**

Course will involve laboratory assignments dealing with measurements of distances and angles; use of EDM, GPS, and automatic levels; traversing; leveling; horizontal curves; vertical curves; and topographic survey. Offered in Summer for DEDP students. Prerequisite: DEDP students must have completed CE 313. Corequisite: On-campus students must be enrolled in CE 313. F.

#### **CE 351. Structural Mechanics. 4 Credits.**

Reactions, shear and bending moment, plane and space trusses, influence lines, deflections, virtual work, energy methods, approximate analysis, consistent deformations method, slope deflection and moment distribution methods, introduction to matrix methods. Use of computer for analysis. Prerequisite: ENGR 203. F.

#### **CE 397. Cooperative Education. 1-8 Credits.**

A practical work experience with an employer closely associated with the student's academic area. Arranged by mutual agreement among student, department and employer. Repeatable to 24 credits. Prerequisite: Admission to the civil engineering program or consent of advisor. Repeatable to 24.00 credits. F,S,SS.

#### **CE 401. Mechanics of Materials II. 3 Credits.**

Theories of stress and strain in two and three dimensions; transformation of stresses and strains in two and three dimensions; tensor notation; linear and nonlinear stress strain behavior; thermal stresses; isotropic, orthotropic, and anisotropic material behavior; yield criteria and theories of failures under combined stresses; energy methods; torsion of noncircular and thin walled sections; unsymmetrical bending; shear center; curved beams. CE 501 cannot be taken after taking CE 401. Prerequisite: ENGR 203. S, odd years.

#### **CE 402. Structural Stability. 3 Credits.**

Concept of stability; equilibrium and energy methods; stability of columns, beam columns, and frames; inelastic buckling; stability by slope deflection and matrix methods; use of codes for the stability design of aluminum and steel columns and frames; torsional and lateral torsional buckling of beams and beam columns. Prerequisite: ENGR 203. On demand.

#### **CE 403. Structural Dynamics. 3 Credits.**

Single-degree and multi-degree of freedom systems; continuous systems; free and forced vibrations; harmonic and periodic excitations; viscous and non-viscous damping; pulse excitations; numerical methods for dynamic response; earthquake response of linear elastic buildings; structural dynamics in building codes. Prerequisite: ENGR 202 and ENGR 203. On demand.

#### **CE 411. Civil Engineering Materials Laboratory. 1 Credit.**

Course involves lab experiences dealing with design of experiments; and determining the properties of coarse and fine aggregates, concrete, asphalt, steel, and wood. Students perform lab work in teams and write reports as a group and/or individually. Prerequisite: CE major, ENGR 203, and ENGL 110. Corequisite: MATH 321 or CHE 315 or ECON 210, and CE 412L. F,SS.

#### **CE 412. Soil Mechanics. 3 Credits.**

Course topics include principles of soil mechanics including weight-volume relationships, classification, compaction, effective stress, permeability and seepage, consolidation, shear strength, site exploration, introduction to lateral earth pressure, and slope stability. Prerequisite: ENGR 203. F.

#### **CE 412L. Soil Mechanics Lab. 1 Credit.**

Course involves lab experiences dealing with design of experiments; and determining the properties of soil in terms of moisture content, specific gravity, grain size distribution, index properties, moisture-density relationships, and permeability. Students perform lab work in teams and write reports as a group and/or individually. Prerequisite: CE major, ENGR 203, and ENGL 110. Corequisite: MATH 321 or CHE 315 or ECON 210; and CE 411 and CE 412. F,SS.

#### **CE 414. Foundation Engineering. 3 Credits.**

Soil improvements and ground modifications, soil exploration and sampling, bearing capacity, spread footings, mat foundations, settlement analysis, drilled shaft and pile foundations, foundations on difficult soil. Prerequisite: CE 412. S.

#### **CE 416. Transportation Engineering. 3 Credits.**

Introduction to highway engineering, traffic analysis, and transportation systems; road vehicle performance; highway, vehicle, and driver characteristics; highway capacity and level of service analysis; level of service analysis for signalized intersections; principles of traffic flow; geometric design of highways; pavement design and drainage; highway safety and transportation planning; and group design project. Prerequisite: CE 412. S.

#### **CE 417. Transportation Asset Management. 3 Credits.**

Course focused on the principles of transportation asset management with an emphasis on pavement management system (PMS). Network- and project-level pavement management processes will be discussed, but the emphasis will be on network-level. Bridge management system will also be covered. Prerequisite: ENGR 203 and a statistics course (MATH 321, CHE 315, ECON 210 or approved substitute). F, even years.

**CE 418. Pavement Engineering. 3 Credits.**

Structural pavement design concepts for flexible and rigid pavements; traffic and environmental loading factors; material characterization; hot mix asphalt design and analysis concepts, SuperPave mix design method, stresses and strains in flexible and rigid pavements, joints and load transfer of rigid pavements, fast track concrete, and construction issues. Prerequisite: CE 412. F.

**CE 419. Sustainable Pavements. 3 Credits.**

Sustainability concepts; overview of mix design, structural design, and construction methods of pavements; warm mix asphalts; recycling of asphalt and concrete pavements, perpetual pavement concepts, specialty pavements, environmental, economic, and social impacts of highway pavements. Prerequisite: CE 412. S.

**CE 421. Hydrology. 3 Credits.**

Course topics include measurement, interpretation, analysis and application of hydrologic data; precipitation, evaporation and transpiration; runoff hydrographs; routing methods; groundwater; and snow hydrology. Computer applications. Prerequisite: CE 306 and CE 423. F.

**CE 423. Hydraulic Engineering. 3 Credits.**

Fluid statics and dynamics; open channel flow; transitions and controls; hydraulic structures; hydraulic machinery; hydraulic power conversion; and hydraulic modeling. Prerequisite: CE 306. S.

**CE 423L. Hydraulic Engineering Laboratory. 1 Credit.**

Course involves lab experiences dealing with design of experiments; and fluid properties, flow measurements, open channel flow, pipe flow, and hydraulic machinery. Students perform lab work in teams and communicate results in written reports and one oral presentation. Prerequisite: CE major, ENGR 203, and ENGL 110. Corequisite: MATH 321 or CHE 315 or ECON 210; and CE 423 and CE 431L. S,SS.

**CE 424. Open Channel Hydraulics. 3 Credits.**

Study of advanced topics in open channel hydraulics. Computer applications. Prerequisite: CE 423. F.

**CE 425. Surface Hydrology. 3 Credits.**

Extreme rainfalls and flood frequency analysis, regionalization; runoff generations, routings, and basin modeling; urban storm water design; GIS and remote sensing applications in hydrology; recent techniques and development in surface hydrology. Prerequisite: CE 421. S.

**CE 426. Applied Hydraulics. 3 Credits.**

Study of advanced topics on the hydraulics and design of water systems including water supply, water storage, drainage, and flow controls. Prerequisite: CE 423. On demand.

**CE 431. Environmental Engineering I. 3 Credits.**

Environmental quality, water quality modeling, water wastewater treatment systems, sludge processing, solid wastes, hazardous wastes, environmental law. Prerequisite: CE 306. S.

**CE 431L. Environmental Engineering Laboratory. 1 Credit.**

Course involves lab experiences dealing with design of experiments; and water and wastewater treatment topics such as BOD, total and suspended solids, water hardness, chlorination, alkalinity, coagulation, and jar testing. Students perform lab work in teams and communicate results in written reports and one oral presentation. Prerequisite: CE major, ENGR 203, and ENGL 110. Corequisite: MATH 321 or CHE 315 or ECON 210; and CE 423L and CE 431. S,SS.

**CE 432. Environmental Engineering II. 3 Credits.**

Water distribution networks, mass curve analysis, wastewater collection systems, pumping systems for water and wastewater, system design project, computer-assisted design, confined spaces. Prerequisite: CE 306. F.

**CE 434. Environmental Engineering Laboratory. 4 Credits.**

Physical, chemical and biological methods used in environmental engineering, water chemistry, instrumental methods, lab tours. On demand.

**CE 435. Hazardous Waste Management. 3 Credits.**

Regulations, generation, storage, transportation, disposal, classification, fate and transport of contaminants, environmental audits, pollution prevention and management facilities, remediation alternatives, physical-chemical treatment, bioremediation, stabilization/solidification, thermal processes. Prerequisite: CE 306 and CHEM 121. S.

**CE 436. Environmental Engineering III. 3 Credits.**

Water chemistry in unit Operation and process design for water and wastewater treatment; physical, chemical, and biological systems; plant design project, computer-assigned design analysis. Prerequisite: CE 431. F.

**CE 437. Environmental Engineering IV. 3 Credits.**

Advanced theory and special methods in municipal and industrial water and wastewater processes including treatment plant control, equipment studies, nutrient removal, contaminant fate and transport, and toxic pollutants control. Prerequisite: CE 431. S.

**CE 444. Contracts and Specifications. 3 Credits.**

Engineering contracts and specification essentials, legal aspects of engineering practice and employment; professional practice issues; procurement of work; governmental regulation. S.

**CE 451. Steel Design. 3 Credits.**

Selection of sections, bolted and welded connections, trusses, bearings, lightgauge structural members, fatigue of structural members and introduction to plastic design. Prerequisite: CE 351. S.

**CE 452. Thin Shell Structures. 3 Credits.**

Differential geometry of shell theory, membrane and bending theories of shells, shells of revolution, stress analysis of domes, pressure vessels, and storage tanks, numerical methods, buckling of shells. CE 552 cannot be taken after taking the CE 452. Prerequisite: ENGR 203 and CE 351. F, odd years.

**CE 453. Reinforced Concrete. 3 Credits.**

Loads and load factors; introduction to the working stress method in reinforced concrete; analysis and strength design of reinforced concrete beams in bending, shear, and development length; design of one way slabs; serviceability requirements for deflection and cracking; axially and eccentrically loaded reinforced concrete columns. The design process is based on ACI 318 building code. Prerequisite: CE 351. F.

**CE 455. Prestressed Concrete-Analysis and Design. 3 Credits.**

Materials and systems of pre-stressing; pre-stress losses; pre-tensioned and post-tensioned members; design of pre-stressed concrete beams by service load and ultimate strength methods; flexural design of composite beams and slabs; anchorage zone stresses and reinforcement; shear and torsion. Prerequisite: CE 453. On demand.

**CE 456. Numerical and Matrix Methods of Structural Analysis. 3 Credits.**

Numerical and Matrix Methods of Structural Analysis Methods of successive approximations and numerical procedures for solution of complex structural problems, matrix formulation of structural problems, flexibility and stiffness methods of analysis. CE 556 cannot be taken after taking CE 456. Prerequisite: CE 351. F, odd years.

**CE 457. Advanced Steel Design. 3 Credits.**

Design and analysis of simple structural connections including both moment and shear connections; design and analysis of eccentric structural connections, plate girders, and composite structures; design and analysis for seismic loads; ASD and LRFD design. Prerequisite: CE 451 or consent of the instructor. F.

**CE 458. Theory of Plasticity. 3 Credits.**

Rigorous study of classical theory of plasticity. Classical continuum mechanics concepts of stress and strain and elastic behavior discussed. Progressing into plastic behavior in materials, mathematical formulation of elasto-plastic constitutive relationship, practical engineering limit analysis, and application of plasticity theories in analysis using computer programs. Prerequisite: CE 451. S.

**CE 459. Plate and Slab Structures. 3 Credits.**

Classical plate bending theory, rectangular and circular plates, slab analysis by energy and numerical methods, anisotropic plates, large deflection theory, buckling of thin plates. CE 559 cannot be taken after taking CE 459. Prerequisite: ENGR 203 and CE 351. S, odd years.

**CE 482. Civil Engineering Design I. 3 Credits.**

This is a comprehensive design course which integrates engineering design and engineering science components of previous and ongoing coursework into a major design experience. Design projects can be in the areas of environmental, geotechnical, structures, water resources, or transportation engineering. Course activities include defining the problem, formulating project objectives, gathering background information, scheduling the project, applying design standards and realistic constraints; developing design alternatives; and evaluating design alternatives. Other topics covered include project management, effective team-working, professional ethics, and applications of graphical communication. Group design reports and individual oral presentations are required. Prerequisite: At least one of CE 412 or CE 451, and at least one of CE 423 or CE 431. F.

**CE 483. Civil Engineering Design II. 3 Credits.**

This is a comprehensive design course which integrates engineering design and engineering science components of previous and ongoing coursework into a major design experience. Design projects can be in the area of environmental, geotechnical, structural, water resources, or transportation engineering. Course activities include developing and analyzing a detailed design, preparing plans and drawings using graphical communication tool(s), developing design specifications, and estimating construction costs. Other topics include principles of sustainability in design, and professional licensure and professional practice issues. Group design reports and individual oral presentations are required. Prerequisite: CE 482 or departmental consent. S.

**CE 490. Special Topics. 1-3 Credits.**

Investigation of special topics dictated by student and faculty interests. Repeatable. Prerequisite: Department approval. Repeatable. F,S.