

Civil Engineering

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Civil Engineering, the oldest branch of the engineering profession, utilizes knowledge of mathematics and science, while applying judgment, to design economic means for improving the well-being of humanity: by providing designs for community living, industry, and transportation; and by designing structures for the use of humankind. One of the rare historical records of civil engineering within academia is contained in the first catalogue of this university, dated August 1821. Among the description of offerings to students in 1820 was . . . "Civil Engineering, including the construction of roads, canals, locks and bridges." This institution was thus the first private school in the United States where students were taught engineering as a separate branch of education. Two of its earliest alumni, Alfred W. Craven and Moncure Robinson, were prominent in the formation of the American Society of Civil Engineers in 1852.

The Civil & Environmental Engineering field encompasses planning, design, construction and maintenance of structures, which often includes altering the natural geography to meet human needs. Civil Engineers plan, design, construct, and maintain suspension bridges, dams, tunnels, skyscrapers, the Interstate highway system, airports, ports, shopping centers, residential developments, water delivery and purification facilities and irrigation systems. During the first two years, students learn the fundamental mathematical and scientific principles essential for engineering analysis and design. Principles of the design process are introduced in the first engineering courses and continually emphasized and practiced in the subsequent engineering courses. The last two years of the curriculum are devoted to providing a sound grounding in five major civil engineering sub-disciplines: water resources, structural, environmental, geotechnical, and construction. The design experience is culminated in the senior year with a major design project. Because laboratory experience is deemed essential to learning, participatory laboratories reinforce principles learned in lectures and permit students to learn through inquiry. To this end, laboratory sections are kept small and require student participation. Use of the computer for both analysis and design is an integral part of the curriculum and the department maintains a computer laboratory for the exclusive use of civil engineering students. Software required for all courses and additional software for student inquiry is available. The curriculum is also strengthened by activities of the Norwich student chapters of the American Society of Civil Engineers, Chi Epsilon, Tau Beta Pi, and the Society of American Military Engineers.

Mission:

The mission of the Civil Engineering Program is:

- Prepare students to excel in civil engineering and related fields.
- Make clear to students that above all else, the Civil Engineering profession is committed to bettering the world.
- Provide fundamental, laboratory-oriented (BSCE level only), hands-on education in the civil engineering field.
- Foster creativity, critical thinking, and problem solving abilities and motivate students to consider the environmental consequences of their work.
- Enable students to be leaders in their profession, community, nation, and the world.

Goals:

Graduates of the Civil Engineering Program will:

- Lead project teams in their chosen field of Civil Engineering research, design, construction, or management, progressively rising to positions of technical leadership
- Be respected and recognized for technical competence in the creation of solutions that balance sustainability, societal and economic issues.
- Become active citizens in their profession, community, the nation and the world.
- Communicate to both technical and non-technical audiences.
- Actively engage in continuing education throughout life.

Outcomes:

Students in the Civil Engineering Program will demonstrate an ability to:

- Apply scientific and fundamental engineering knowledge based upon a strong foundation in advanced mathematics, chemistry, physics, and the engineering sciences.
- Design and conduct hands-on experiments, use appropriate laboratory equipment to develop, analyze and interpret data.
- Design a component system or process in the civil engineering field that meets performance, quality, cost, time, safety, environmental, and sustainable requirements.
- Function as a member of a multidisciplinary team and be able to assume leadership roles on the team.
- Determine into which technical area of civil engineering a project belongs and be able to analyze a project within at least four technical areas.
- Recognize and achieve a high level of professional and ethical conduct in all aspects of engineering work and can analyze a professional dilemma.
- Formulate and deliver effective written and verbal communications of laboratory, analytical and design project work to a variety of audiences.
- Understand and incorporate non-technical considerations into an engineering solution including safety, environmental, social, economic, and global issues.
- Recognize the need for civil engineers to engage in lifelong learning and begin the process by taking the FE examination.
- Be knowledgeable of contemporary issues in civil engineering.
- Utilize techniques, skills and modern engineering tools necessary for civil engineering practice.
- With the knowledge that engineering changes society, civil engineers must understand that they are leaders.

Careers for this Major:

Graduate from this program manage varying job demands and requirements and are capable of adapting to rapidly changing technology. Graduates are also prepared for further formal study in graduate school where a student can specialize in a civil engineering sub-discipline. Whether working for a private engineering firm, construction firm, government agency, or industry, there are many areas in which civil engineers can focus. A few of the major specialties include:

- Structural (buildings, bridges, tunnels)

- Geotechnical (retaining structures, foundations)
- Water and wastewater (water supply, sewage disposal)
- Hydrology (river control, drainage)
- Transportation (highways, airports, railroads)
- Environmental (hazardous waste, air pollution, water quality)

The American Society of Civil Engineers is the largest professional organization that serves Civil and Environmental Engineers, as well as many other types engineers in associated fields. To learn more about

employment opportunities in Civil and Environmental Engineering, please visit: <http://careers.asce.org> .

Accreditation:

The Civil Engineering Program is accredited by the Engineering Accreditation Commission (EAC) of ABET, <http://www.abet.org> , 415 N. Charles Street. Baltimore, MD 21201, Telephone: (410) 347-7700.

B.S. in Civil Engineering - Curriculum Map

Freshman			
Fall	Credits	Spring	Credits
CH 103 General Chemistry I (General Education Lab Science)	4	CH 104 General Chemistry II (General Education Lab Science)	4
EG 109 Introduction to Engineering I	3	EG 110 Introduction to Engineering II	3
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
MA 121 Calculus I	4	MA 122 Calculus II (General Education Math)	4
		General Education: History/Literature/Arts & Humanities/Social Science	3
	14		17
Sophomore			
Fall	Credits	Spring	Credits
CE 211 Surveying	3	CE 214 Site Development and Engineering	4
CE 264 Specifications and Estimating	1	EG 202 Engineering Mechanics (Statics,Dynamics)	3
EG 201 Engineering Mechanics (Statics, Dynamics)	3	EG 206 Thermodynamics I	3
MA 223 Calculus III (General Education Math)	4	MA 224 Differential Equations	4
PS 211 University Physics I	4	Science Elective*	3
General Education : History/Literature/Arts & Humanities/Social Science	3		
	18		17
Junior			
Fall	Credits	Spring	Credits
EG 350 Engineering Economics and Decision Analysis	3	CE 322 Fluid Mechanics Laboratory	1
CE 321 Materials Laboratory	1	CE 328 Soil Mechanics	4
CE 336 Introduction to Transportation Engineering	3	CE 332 Engineering Hydrology	3
CE 421 Environmental Engineering	4	CE 348 Structural Analysis	3
EG 301 Mechanics of Materials	3	CE 422 Waste and Water Treatment	3
EG 303 Fluid Mechanics	3	EN 204 Professional and Technical Writing	3
	17		17
Senior			
Fall	Credits	Spring	Credits
CE 419 Foundation Engineering	3	CE 444 Reinforced Concrete Design	3
CE 442 Design of Steel Structures	3	CE 480 Senior Design (Capstone)	3
CE 460 Construction Management	3	General Education: History/Literature/Arts & Humanities/Social Science	3
CE 475 Senior Project Planning	1	General Education: History/Literature/Arts & Humanities/Social Science	3
EE 315 Electrical Energy Systems	3	Science Elective*	4
EG 044 Conference	0		
EG 450 Professional Issues (General Education Ethics)	3		
	16		16
Total Credits: 132			

An undergraduate student, who has completed all degree requirements except for attaining a 2.00 average, must take at least 50 percent of all

subsequent course work in technical material (subject to approval by the School Director).

All Civil Engineering majors are required to take the Fundamentals of Engineering (F.E.) exam, administered by the State of Vermont or other state, to receive the BSCE degree.

*Science Electives: BI 101, BI 102, BI 220, BI 275, BI 405, CH 204, CH 205, CH 327, ES 270, GL 110, GL 111, GL 156, GL 253, GL 255, GL 257, GL 262, GL 265, ID 110, PS 212. Must include at least one science course that is in an area other than chemistry or physics.

Courses

CE 211 Surveying 3 Credits

A course in the theory and practice of plane surveying. Horizontal and vertical control, design of circular and parabolic curves, tachometry, construction surveys and earthwork quantities are covered in lecture. Fieldwork presents the practical applications of lecture material with the use of transits, tapes, levels, electronic distance measuring devices and theodolites. Classroom 2 hours, laboratory 3 hours. Prerequisite: MA 107.

CE 214 Site Development and Engineering 4 Credits

A course that teaches the tasks and considerations involved in environmentally sound land development. Road design and its interaction with development sites will be presented. Other topics covered include contours, drainage utilities, cut and fill, and aesthetic considerations. Codes and legal requirements will also be covered. CADD (Computer Aided Drawing and Design) software specific to Civil Engineering work will be introduced and employed extensively on student projects. Classroom 3 hours, laboratory 3 hours. Prerequisite: CE 211.

CE 220 Introduction to Environmental Technology 4 Credits

A study of the fundamentals of environmental control technology. The course covers the topics of air pollution, water pollution, solid and hazardous wastes, and radioactive wastes. Noise pollution and control are also covered. The generation and treatment of wastes along with their effects on the environment are included in the course. The laboratory includes the basic methods of measuring pollution. Three Credits: Classroom 3 hours. Four Credits Classroom 3 hours, laboratory 2 hours. Prerequisite: CH 103. Not open to engineering students.

CE 264 Specifications and Estimating 1 Credit

A laboratory in plan reading, quantity analysis and cost estimating of Civil Engineering projects. Students will be exposed to standard formats for specifications and estimating. Students will write sample specifications and will gain experience in construction estimation. Laboratory 3 hours. Co-requisites: CE 211.

CE 318 Soil Mechanics 3 Credits

An introduction to the engineering properties of soil: soil classification; soil structure and mineralogy; water flow through soils; compressibility and consolidation; shear strength. Laboratory testing of soils and soil exploration. Offered to allow students from other institutions to transfer 3 credit equivalent courses.

CE 321 Materials Laboratory 1 Credit

A laboratory course in the application of basic mechanics of materials principles to cement, aggregate, concrete, steel and wood. Operation of various types of testing machines and gauges. Tests of tension, compression, flexure, torsion, impact, shear, hardness and fatigue. Laboratory observations, analysis, interpretation and reports. Classroom 1 hour, laboratory 2 hours. Corequisite: EG 301 or CE 351.

CE 322 Fluid Mechanics Laboratory 1 Credit

A laboratory course in which the principles of fluid mechanics are applied to civil engineering problems. The design and implementation of a laboratory research study, the analysis of data, the presentation of results, and the development of engineering conclusions are integral parts of this course. Lab topics include hydrostatics, pipeflow, open channel flow, flow measurement, and resistance to flow. Classroom 1 hour, laboratory 2 hours. Prerequisite or concurrent enrollment: EG 303.

CE 328 Soil Mechanics 4 Credits

An introduction to the engineering properties of soil: soil classification; soil structure and mineralogy; water flow through soils; compressibility and consolidation; shear strength. Laboratory testing of soils and soil exploration. Classroom 3 hours, laboratory 2 hours. Prerequisite: EG 301 or permission of the instructor.

CE 332 Engineering Hydrology 3 Credits

A study of the location, movement, and distribution of the waters of the earth for practical applications to society. This course includes the study of the engineering aspects of precipitation, evaporation, infiltration, streamflow and flood and drought prediction. The application of hydrological statistics and computer applications are stressed. Classroom 3 hours. Prerequisite: EG 303 or permission of the instructor.

CE 336 Introduction to Transportation Engineering 3 Credits

An introduction to different modes of transportation with emphasis on roadway and traffic engineering. Topics include transportation planning, highway geometric and pavement design, drainage, construction, traffic-control devices, traffic operations and management, and highway capacity analysis. Classroom 3 hours. Prerequisites: CE 211: Surveying.

CE 348 Structural Analysis 3 Credits

A course on the analysis of statically determinate and indeterminate beams, frames and trusses. Topics include loads to buildings, shear and moment diagrams, influence lines and classical methods of analysis. Computer applications are introduced using a general frame analysis program. The use of analysis in the overall design process is stressed using a semester-long project. Classroom 3 hours. Prerequisite: EG 301.

CE 351 Statics and Mechanics of Materials 4 Credits

A study of elementary, primarily two-dimensional engineering mechanics. Fundamental concepts and basic laws of statics, force systems, structures, and support reactions for loading patterns. Stress-strain relationships to forces: concepts and applications. Consideration of engineering materials and their suitability in various structures and mechanisms. Classroom 4 hours. Prerequisites: MA 107 and PS 201. Not open to engineering students.

CE 419 Foundation Engineering 3 Credits

A course on the use of soil properties to determine bearing capacity and settlement of shallow and deep foundations. Design of earth and earth supporting structures. Classroom 3 hours. Prerequisite: CE 328 or permission of the instructor.

CE 421 Environmental Engineering 4 Credits

Sources, quantities and constituents of water and wastewater are examined and their interaction with the environment is developed. Design of chemical, physical and biological treatment facilities according to current practice is stressed. The laboratory develops standard methods of chemical, physical and biological examination and analysis. Classroom 3 hours, laboratory 3 hours. Co-requisite: CE 211.

CE 422 Waste and Water Treatment 3 Credits

A study of physical, chemical and biological processes for water and wastewater treatment. The course emphasizes the evaluation of unit processes and the design of water and wastewater treatment facilities. Classroom 3 hours. Prerequisite: CE 421.

CE 432 Solid and Hazardous Waste Engineering 3 Credits

A course on the state-of-the-art techniques for disposal of solid and hazardous waste material. Aspects covered will be system design, public health protection, and environmental protection. Classroom 3 hours. Prerequisites: CH 104 and junior or senior status in engineering or science.

CE 441 Transportation Engineering 3 Credits

The planning, design, and construction of transportation systems to meet the mobility requirements of society while considering economic, environmental, and societal constraints. System maintenance and administration are also included. Classroom 3 hours. Prerequisite: CE 211 or permission of the instructor.

CE 442 Design of Steel Structures 3 Credits

An introduction to the design of metal structures using the LRFD-AISC code as the basis. Topics include design of tension, compression and bending members; bolted and welded connections. Classroom 3 hours. Prerequisite: CE 348.

CE 444 Reinforced Concrete Design 3 Credits

An introduction to the design of reinforced concrete members under bending, shear and axial loadings according to ACI 318R code requirements. Topics also include one-way slabs, footings and retaining walls and an introduction to pre-stressed concrete. Use of the computer as a design tool is introduced. Classroom 3 hours. Prerequisite: CE 348.

CE 446 Soils in Construction 4 Credits

This is the first course in geotechnical engineering, one of the sub-disciplines of Civil Engineering. Its purpose is to impart knowledge of the engineering properties and behavior of soils that are used for construction of foundations and earth structures. Classroom 3 hours, laboratory 2 hours. Prerequisite: Junior standing or higher.

CE 450 Air Pollution Control 3,4 Credits

A course presenting sources of air pollution and the effect on the environment, the measurement of air pollutants, modeling of air pollutant dispersion, and design of control measures. Use of manual monitoring techniques and physical and chemical fundamentals to measure air quality. Course may be taken for three credits without the lab. Classroom 3 hours, laboratory 3 hours. Prerequisite: EG 206.

CE 451 Air Pollution Control Equipment Design 3 Credits

This course builds on and amplifies material studied in CE 450. Properties of air pollutant emissions and thermodynamics, fluid mechanics and heat transfer principles are utilized to design air pollution control equipment. Several major design projects are undertaken by student teams; interim and final design reports are required. In addition, a module on air quality modeling is included. Classroom 3 hours. Prerequisite: CE 450.

CE 452 Introduction to Air Pollution Control 3 Credits

A course presenting sources of air pollution and the effect on the environment, the measurement of air pollutants, modeling of air pollutant dispersion, and design of control measures. Classroom 3 hours, laboratory 3 hours. Prerequisite: EG 206.

CE 455 Structures I 3 Credits

This course builds directly on the material learned in CE 351 and is specifically directed to the study of the response of structural systems to various loadings. Gravity and lateral loads as well as load combinations on a structure are developed using appropriate building codes. The response of the structural system to imposed loading is studied by classical and computer analysis techniques. Finally, this course introduces the students to the design of simple steel structures that meet the appropriate building code. Classroom 3 hours. Prerequisite: CE 351. Not open to engineering majors.

CE 456 Structures II 3 Credits

This course is intended to introduce the students to and develop an understanding of, structural design of wood, concrete and masonry. Particular attention will be given to failure modes of the member types and materials. Each of the principal member types, beam and column as well as connections, will be studied and members designed to meet the appropriate code. Classroom 3 hours. Prerequisite: CE 455. Not open to engineering majors.

CE 457 Wood, Steel, and Concrete Structures 4 Credits

This course builds directly on the material learned in CE 351 and is specifically directed to the study of the response of structural systems to various loadings. Gravity and lateral loads as well as load combinations on a structure are developed using appropriate building codes. The response of the structural system to imposed loading is studied by classical and computer analysis techniques. This course introduces the students to applications - the design of simple structures of wood, steel, concrete and other materials that meet the appropriate building code. Classroom 4 hours. Prerequisite CE 351. Not open to engineering majors.

CE 458 Structural Issues for Construction 3 Credits

This course is intended to introduce the students to structural building applications, and to develop knowledge and comprehension of structural design of steel, wood, concrete, and masonry. Particular attention will be given to concrete members, concrete form design requirements, steel connections, failure modes of the member types and materials. Detailed construction issues with each material will be emphasized. Each of the principal member types, beam and column as well as connections, will be studied and members designed to meet the appropriate code. Lecture 3 hours. Prerequisites: CE 455 or CE 457. Not open to engineering majors.

CE 460 Construction Management 3 Credits

A course on the organization, scheduling and management of the construction project utilizing CPM and PERT. Survey of management functions by which construction is authorized, purchased, supervised, accomplished, inspected and accepted, including labor management relations and site design. Classroom 3 hours. Prerequisite: MA 107.

CE 475 Senior Project Planning 1 Credit

Each student will work with a mentor and together will define and analyze a project so that an efficient design can be completed. The project scope will be developed, tasks will be laid out, and a schedule to complete the project will be created. All of this will be presented orally and in written form in a project proposal. Prerequisite: Senior status. Corequisite: CE 460.

CE 480 Senior Design 3 Credits

A capstone course in civil engineering. This course builds on and integrates the engineering concepts developed in prior course work into the complete design of a major civil engineering project. The course will require a written and an oral presentation of the completed design to include, where appropriate, plans and specifications. Prerequisites: CE 328, CE 348, and CE 421, or departmental approval.

CE 490 Advanced Topics 4 Credits

A course that provides instruction in an area of the instructor's special competence and student interests. Advanced topics would be presented in such areas as air pollution control, water and wastewater treatment, bioremediation, and nuclear radiation. Offered as the occasion demands. Prerequisite: senior standing.

CE 499 Applied Soils and Foundations 4 Credits