

BACHELOR OF ENGINEERING IN CIVIL ENGINEERING

Welcome from the Program Coordinator

Civil engineers are responsible for planning, designing, and overseeing the construction of essential infrastructure, such as buildings, bridges, highways, levees, dams, water and wastewater treatment facilities, ports, railroads, and airports.

The undergraduate Civil Engineering (CE) program at Youngstown State University (YSU) offers a Bachelor of Engineering (B.E.) in Civil Engineering through an ABET-accredited curriculum designed to be completed in four years. Students begin with a strong foundation in mathematics and science, which prepares them for advanced coursework in civil engineering. Learning extends beyond the classroom through hands-on experiences, such as co-ops and internships, undergraduate research, laboratory work, and participation in student competitions such as the Concrete Canoe and Steel Bridge.

At YSU, we believe civil engineers make the world a better place. Guided by this philosophy, we prepare our students to take on challenging engineering roles and leadership positions in the development of our communities and infrastructure. By graduation, students are well-equipped to begin careers in all five major sub-disciplines of civil engineering: Structural, Transportation, Geotechnical, Water Resources, and Environmental Engineering. Our faculty hold doctoral degrees and professional engineering (P.E.) licenses in their respective fields, ensuring they remain active and current through continuing education.

YSU CE students gain practical experience by participating in the American Society of Civil Engineers (ASCE) Student Chapter. Each year, they design and build steel bridges and concrete canoes from the ground up, competing in regional and national events. In 2023, the Steel Bridge Team placed second in the National Student Steel Bridge Competition, and the Concrete Canoe Team also earned second place at the National Concrete Canoe Competition. Through these activities – as well as internships, co-ops, and ASCE involvement – students build strong professional networks and gain valuable real-world experience.

For more information about the CE program at YSU, please contact:

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Mission

The mission of the Civil Engineering program is to:

1. offer high-quality bachelor's degree in civil engineering that encompasses basic engineering sciences, as well as both traditional and emerging areas of the discipline;
2. prepare graduates to adapt to global and domestic engineering challenges and changing industry practices;
3. foster student-faculty relationships that enrich teaching and learning, develop scholarship, and encourage public service;
4. maintain an academic structure characterized by integrity, and by respect for students, society, the environment, and the civil engineering profession;
5. prepare graduates for, and facilitate, lifelong intellectual and professional development; and

6. contribute to economic prosperity of the region, state, and nation by enhancing the size and competitiveness of the civil engineering workforce.

Admission into the Program

To be admitted into the program, students are required to have an overall GPA of 2.3 and a grade of "C" or higher in CHEM 1515/L, MATH 1571, and ENGL 1550. Students can only repeat these courses one time.

Graduation Policy

In addition to the overall recalculated "C" average required by the University, an unrecalculated "C" average in the major is required. Also, an unrecalculated "C" average in all engineering courses is required.

Program Educational Objectives

The Civil Engineering program equips graduates with the knowledge and skills necessary for productive and rewarding careers. Within a few years after graduation, the graduates are expected to:

1. Perform essential functions on multidisciplinary teams in their professional careers in civil engineering.
2. Demonstrate necessary communication, management, leadership, and interdisciplinary technical skills to excel in engineering and non-engineering sectors.
3. Continue their intellectual, social, and professional growth through lifelong learning and advanced degrees.
4. Obtain professional engineering licensure.

Student Outcomes

The YSU undergraduate program in Civil Engineering adopted the following student outcomes that prepare its graduates to attain the program educational objectives listed above. At the time of graduation, the graduates should have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Program Description

In the first two years into the program, students take coursework in the fundamentals of engineering, mathematics and basic science in order to strengthen their technical background and develop intellectual maturity. They continue in a broad-based civil engineering program that helps them develop competency in a variety of areas within the discipline. Topics include structural, geotechnical, transportation, environmental, and water resources engineering, as well as surveying and construction management. In their last two years, students choose elective courses in various sub-disciplines of civil engineering based on their academic and career interests.

Instruction on the design process is fully integrated throughout the curriculum to foster the depth of understanding and self-confidence that students will

need to think creatively and become productive engineers. The curriculum is based on the fundamental concept that students can best develop their creative skills through a series of progressively more demanding design experiences leading up to a major, comprehensive senior-level complex engineering design project.

Students in the CE program earn a Bachelor of Engineering (B.E.) in Civil Engineering degree. Graduates are prepared for advanced studies at the master's and doctoral levels in engineering, or for employment in the engineering profession.

The CE program offers the atmosphere of a small school in maintaining a close contact between faculty and students. Faculty members and staff serve as academic advisors and are engaged in all phases of instruction from freshman to graduation. All facilities of the CE program are located within Moser Hall. The program maintains laboratories for strength of materials, concrete testing, soil mechanics, surveying, environmental engineering, and fluid mechanics. A wide variety of equipment is available in these laboratories to support both teaching and research activities.

Accreditation

The YSU undergraduate program in Civil Engineering has been accredited by the Engineering Accreditation Commission of ABET (<https://www.abet.org>), under the commission's General Criteria and Program Criteria for Civil and Similarly Named Engineering Programs.

Civil Engineering Faculty

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Co-ops/Internships in Civil Engineering

The Civil Engineering program strongly encourages its students to participate in co-ops and internships. A co-op is defined as a structured developmental program with increasing responsibilities in a full time position for at least one year (Fall, Spring, and Summer). An internship is a project-based learning experience that lasts from a few weeks to a semester, and may be completed part-time or full-time or part-time while attending classes. While academic credit may be awarded for both co-ops and internships, these credits do not count toward the B.E. in Civil Engineering degree. Students should register with the STEM Professional Services office to participate in these opportunities.

For more information on co-ops and internships, contact Dr. Anwarul Islam, Professor and Program Coordinator of Civil Engineering.

Curriculum Sheet

COURSE	TITLE	S.H.
FIRST YEAR REQUIREMENT - STUDENT SUCCESS		
YSU 1500	Success Seminar	1-2
or YSU 1500S	Youngstown State University Success Seminar	
or HONR 1500	Intro to Honors	
GENERAL EDUCATION REQUIREMENTS		
ENGL 1550	Writing 1	3-4
or ENGL 1549	Writing 1 with Support	
ENGL 1551	Writing 2	3
Arts and Humanities Elective 1		
PHIL 2625	Introduction to Professional Ethics	3
or PHIL 2628	Business Ethics	
Any Arts and Humanities Course		
Social Sciences Electives		
Any 2 Social Sciences Courses		
NATURAL SCIENCE (2 lecture + 1 lab 7 s.h.)		
CHEM 1515 & 1515L	General Chemistry 1 and General Chemistry 1 Laboratory	4
PHYS 2610	General Physics 1	4
General Education Elective (9 s.h.)		
CMST 1545	Communication Foundations	3
General Education Electives -Select 2 Courses		
MATHEMATICS (one course meets Gen Ed requirement)		
MATH 1571	Calculus 1	4
MATH 1572	Calculus 2	4
MATH 2673	Calculus 3	4
MATH 3705	Differential Equations	3
ISEN 2610	Engineering Statistics	3-4
or STAT 3743	Probability and Statistics	
FIRST-YEAR ENGINEERING COURSES		
ENGR 1500	Engineering Orientation	1
ENGR 1550	Engineering Concepts	2
ENGR 1560	Engineering Computing	2
MAJOR FUNDAMENTAL COURSES		
CHEM 1516 & 1516L	General Chemistry 2 and General Chemistry 2 Laboratory	4
or PHYS 2611	General Physics 2	
GEOL 2611	Geology for Engineers	3
or BIOL 2601	General Biology 1: Molecules and Cells	

MECH 2641	Dynamics	3
ISEN 2624	Engineering Economy	3
CIVIL ENGINEERING MAJOR COURSES		
CEEN 2601	Statics	3
CEEN 2602	Strength of Materials	3
CEEN 2602L	Strength of Materials Lab	1
CEEN 2610	Surveying	3
CEEN 2610L	Surveying Laboratory	1
CEEN 2660	Computer Aided Design and Drafting	2
CEEN 3716	Fluid Mechanics	3
CEEN 3716L	Fluid Mechanics Lab	1
CEEN 3717	Hydraulic Design	4
CEEN 3720	Transportation Engineering	3
CEEN 3736	Fundamentals of Environmental Engineering	3
CEEN 3749	Structural Analysis 1	3
CEEN 3749L	Structural Analysis 1 Lab	1
CEEN 4812	Construction Management	3
CEEN 4863	Integrated Design Project	3
CEEN 4863L	Integrated Design Project Lab	1
CEEN 4881	Geotechnical Engineering	3
CEEN 4881L	Geotechnical Lab	1
CEEN 5855	Reinforced Concrete Design	3
CEEN 5856	Steel Design	3
CEEN Electives:		
CEEN Design Elective: Select one course. 3		
CEEN 4835	Highway Design	
CEEN 5820	Pavement Material and Design	
CEEN 5837	Environmental Engineering Design	
CEEN 5869	Design of Air Pollution Control Systems	
CEEN 5882	Foundation Engineering	
CEEN 5883	Bridge Engineering	
CEEN Electives: Select two courses. 6		
CEEN 3751 & 3751L	Water Quality Analysis and Water Quality Analysis Lab	
CEEN 4835	Highway Design	
CEEN 5820	Pavement Material and Design	
CEEN 5829	Civil Engineering Materials - Concrete	
CEEN 5832	Natural Systems Engineering	
CEEN 5836	Environmental Water Chemistry	
CEEN 5837	Environmental Engineering Design	
CEEN 5849	Structural Analysis 2	
CEEN 5869	Design of Air Pollution Control Systems	
CEEN 5880	Advanced Hydraulics	
CEEN 5882	Foundation Engineering	
CEEN 5883	Bridge Engineering	
CEEN 5884	Solid and Hazardous Waste Management	
Total Semester Hours		129-132
Four-year Plan		
Year 1		
Fall		
YSU 1500	Success Seminar	1-2
or YSU 1500S	or Youngstown State University Success Seminar	
or HONR 1500	or Intro to Honors	
ENGL 1550	Writing 1	3-4
or ENGL 1549	or Writing 1 with Support	

CHEM 1515 & 1515L	General Chemistry 1 and General Chemistry 1 Laboratory	4
ENGR 1500	Engineering Orientation	1
ENGR 1550	Engineering Concepts	2
MATH 1571	Calculus 1	4
Arts and Humanities Elective 1		
PHIL 2625 or PHIL 2626 or PHIL 2628	Introduction to Professional Ethics or Engineering Ethics or Business Ethics	3
Semester Hours		18-20
Spring		
ENGL 1551	Writing 2	3
ENGR 1560	Engineering Computing	2
MATH 1572	Calculus 2	4
CMST 1545	Communication Foundations	3
Arts and Humanities Elective 2		
Semester Hours		15
Year 2		
Fall		
MATH 2673	Calculus 3	4
CEEN 2601	Statics	3
CEEN 2610	Surveying	3
CEEN 2610L	Surveying Laboratory	1
PHYS 2610	General Physics 1	4
Semester Hours		15
Spring		
MATH 3705	Differential Equations	3
CEEN 2602	Strength of Materials	3
CEEN 2602L	Strength of Materials Lab	1
GEOL 2611 or BIOL 2601	Geology for Engineers or General Biology 1: Molecules and Cells	3
CEEN 2660	Computer Aided Design and Drafting	2
PHYS 2611 or CHEM 1516 and CHEM 1516L	General Physics 2 or General Chemistry 2 and General Chemistry 2 Laboratory	4
Semester Hours		16
Year 3		
Fall		
CEEN 3716	Fluid Mechanics	3
CEEN 3716L	Fluid Mechanics Lab	1
CEEN 3720	Transportation Engineering	3
CEEN 3736	Fundamentals of Environmental Engineering	3
CEEN 3749	Structural Analysis 1	3
CEEN 3749L	Structural Analysis 1 Lab	1
ISEN 2610 or STAT 3743	Engineering Statistics or Probability and Statistics	3-4
Semester Hours		17-18
Spring		
CEEN 3717	Hydraulic Design	4
CEEN 4881	Geotechnical Engineering	3
CEEN 4881L	Geotechnical Lab	1
CEEN Elective 1		3
General Education Elective 1		
General Education Elective 2		
Semester Hours		17

Year 4**Fall**

CEEN 4812	Construction Management	3
CEEN 5855	Reinforced Concrete Design	3
CEEN 5856	Steel Design	3
CEEN Elective 2: CEEN Design Elective		3
ISEN 2624	Engineering Economy	3

Semester Hours	15
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Spring

CEEN 4863	Integrated Design Project	3
CEEN 4863L	Integrated Design Project Lab	1
CEEN Elective 3: May substitute with approval of CE Program Coordinator.		3
MECH 2641	Dynamics	3
Social Sciences Elective 1		3
Social Sciences Elective 2		3

Semester Hours	16
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Total Semester Hours	129-132
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Program Educational Objectives

The Civil Engineering program will provide graduates with the foundation of knowledge and skills necessary for productive and rewarding careers. The program prepares graduate to achieve the following educational objectives within a few years after graduation:

1. Perform essential functions on multidisciplinary teams in their professional careers in civil engineering.
2. Demonstrate necessary communication, management, leadership, and interdisciplinary technical skills to excel in engineering and non-engineering sectors.
3. Continue their intellectual, social, and professional growth through lifelong learning and advanced degrees.
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3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

CEEN 2601 Statics 3 s.h.

Principles of engineering mechanics as applied to statics with vector applications to forces and moments; centroid and center of gravity; equilibrium; friction; moments of inertia: relationship between loads, stress and strain in tension, compression, torsion and bending.

Prereq.: MATH 1572 or MATH 1572H; PHYS 2610 or concurrent.

CEEN 2602 Strength of Materials 3 s.h.

Relationships between loads, shear and bending moments in beams; combined stresses in beams; indeterminate beam analysis; virtual load; connections; columns.

Prereq.: CEEN 2601.

CEEN 2602L Strength of Materials Lab 1 s.h.

Experimental verification of strength of materials; testing: tension, torsion, non-destructive tests of steel; concrete compression and Poisson ration, wood tests.

Coreq.: CEEN 2602.

CEEN 2610 Surveying 3 s.h.

The theory of surveying and the use of instruments. Problems in leveling, traversing, and topography. Introduction to circular and vertical curves.

Prereq.: MATH 1513 or equivalent.

CEEN 2610L Surveying Laboratory 1 s.h.

Field surveying principles and techniques. Uses of transit and level are stressed. Three laboratory hours per week.

Coreq.: CEEN 2610.

CEEN 2660 Computer Aided Design and Drafting 2 s.h.

This course is designed for students who wish to be involved with the civil engineering design fields and for those interested in computer aided design and drafting. Students will be introduced to both traditional and computer aided design and drafting skills. The aim of this course is to introduce students to basic information, skills, and concepts related to drafting and design. Special attention is given to: sketching, measurement, room planning, multi-view drawing, auxiliary views, working drawings, sectional views, orthographic drawings along with AutoCAD tools and commands. The course includes 1 s.h. lecture and 1 s.h. lab.

CEEN 3710 Civil Engineering Materials 3 s.h.

A study of the principal materials used for civil engineering and construction purposes, with special attention paid to physical and mechanical properties of the materials and their importance to the engineer.

Prereq.: CEEN 2602.

CEEN 3711 Technology and Society 3 s.h.

A critical exploration of how societal needs affect the creation of technologies and how technology affects society. The course is interdisciplinary in nature and presents various approaches to examining the complex interaction between humans and their tools. Topics include: (1) technology in human history; (2) society, science, and technology development; (3) technology and social change; (4) technology, knowledge, and power; (5) technology, population, and the environment. Listed also as SOC 3789.

Prereq.: Junior standing or consent of instructor.

CEEN 3716 Fluid Mechanics 3 s.h.

Proportions of fluids, fluid statics, kinematics; Bernoulli equation; fluid momentum; laminar and turbulent flow through simple pipes; boundary layers; dimensional analysis and similitude.

Prereq.: CEEN 2602.

CEEN 3716L Fluid Mechanics Lab 1 s.h.

Experimental verification of the principles of fluid mechanics as applied to incompressible fluid. Three hours laboratory per week.

Prereq.: CEEN 2602.

Coreq.: CEEN 3716.

CEEN 3717 Hydraulic Design 4 s.h.

Analysis of flow in complex pipe systems; pumps; open channel flow; culverts; spillways; storm water drainage. Three hours lecture and three hours of computational laboratory per week.

Prereq.: CEEN 2610 and CEEN 3716.

CEEN 3720 Transportation Engineering 3 s.h.

Introductory survey of transportation topics including transportation systems, vehicular operation and control, and transportation planning techniques; introduction to design of highways, airports, and railroads; and traffic engineering.

Prereq.: CEEN 2610.

CEEN 3736 Fundamentals of Environmental Engineering 3 s.h.

Causes and effects of water, air and land pollution; measurements of environmental quality; environmental regulations; introduction to methods of pollution control.

Prereq.: CHEM 1515.

CEEN 3749 Structural Analysis 1 3 s.h.

The determination of shears, moments, and stresses in statically determinate beams, frames, and trusses. Consideration of dead, live, moving, and wind loads. Elastic deflections of simple structures. Introduction to the analysis of statically indeterminate structures using numerical and energy methods.

Prereq.: CEEN 2602.

CEEN 3749L Structural Analysis 1 Lab 1 s.h.

Introduction to stiffness-based analysis of determinate and indeterminate structures. Computer analysis of various structural systems, including plane and space trusses, continuous beams, plane and space frames, plates. P-delta stability analysis of frames. Three hours computational lab per week.

Prereq.: CEEN 2602; concurrent with CEEN 3749.

CEEN 3751 Water Quality Analysis 3 s.h.

Introduction to physical, chemical, and biological measurements of water quality. Sample collection and laboratory analysis of natural waters, drinking water, and wastewater. Interpretation of environmental data. Two hours lecture and three hours laboratory per week. Identical to ENST 3751.

Prereq.: CEEN 3736 or ENST 2600; CHEM 1515.

CEEN 3751L Water Quality Analysis Lab 0 s.h.

Laboratory experience in the analysis of natural waters, drinking water and wastewater. Emphasizes procedures for the collection and interpretation of data on current environmental problems. Three hours laboratory per week. Must be taken concurrently with CEEN 3751.

CEEN 4800 Special Topics 3 s.h.

Special topics and new developments in Civil Engineering. Subject matter, credit hours, and special prerequisites to be announced in advance of each offering. May be repeated to a maximum of 6 s.h.

Prereq.: Senior standing or consent of instructor.

CEEN 4812 Construction Management 3 s.h.

Fundamentals of construction management: contracts, bonding, estimating, organization, finance; cost and productivity of equipment, material, and labor; and project planning and scheduling.

Prereq.: CEEN 3717 or CEEN 4881.

CEEN 4835 Highway Design 3 s.h.

Methods of highway route location; design methods and standards for highways, intersections, freeways, and interchanges. Includes extensive use of computer-aided design.

Prereq.: CEEN 3720.

CEEN 4863 Integrated Design Project 3 s.h.

Students will be required to complete a culminating design experience that focuses attention on professional practice and is predicated on the accumulated background of curriculum components. Three hours of lecture.

Prereq.: CEEN 5855 and GPA of 2.0 or better.

Coreq.: CEEN 4863L.

CEEN 4863L Integrated Design Project Lab 1 s.h.

Students will be required to complete a meaningful design experience that focuses attention on professional practice and is predicated on the accumulated background of curriculum components. Three hours of laboratory a week.

Prereq.: CEEN 5855 and GPA of 2.0.

Coreq.: CEEN 4863.

CEEN 4879 Civil Engineering Analysis 3 s.h.

Application of mathematical and numerical methods to the systematic analysis and development of problems in the field of Civil Engineering.

Prereq.: CEEN 3749.

CEEN 4881 Geotechnical Engineering 3 s.h.

Properties of soil, classification, capillarity, seepage, permeability, stresses, consolidation, shear strength; analysis and design of foundation structures, retaining walls, piles, drilled piers, sheet pile walls, special footings, stability.

Prereq.: MATH 2673; CEEN 3749.

CEEN 4881L Geotechnical Lab 1 s.h.

Typical soil testing procedures and physical testing of soil samples.

Prereq.: Concurrent with: CEEN 4881.

CEEN 5820 Pavement Material and Design 3 s.h.

Design methods for flexible, rigid and other wheel-supporting pavements to include investigation, testing and preparation of subgrade, base course and pavement materials, design of various pavement mixtures, stresses in pavements, pavement design, and strengthening existing pavements.

Prereq.: CEEN 3720 and CEEN 4881.

CEEN 5829 Civil Engineering Materials - Concrete 3 s.h.

A course designed to broaden the student's understanding of Portland Cement Concrete as a construction material. Topics include the study of cement, hydration of cement, aggregates, admixtures for concrete, mix design handling and placing, curing and properties of Portland Cement Concrete. Testing of Concrete, quality control and special concretes are also included. A library research paper on a concrete-related topic of the student's choice is required.

Prereq.: CEEN 3749 or permission of instructor.

CEEN 5832 Natural Systems Engineering 3 s.h.

Introduction to the features, functions and values of natural aquatic systems, and engineering approaches to analysis and restoration design. Focus on wetlands and streams. Topics include regulations, wetland delineation, constructed wetland design, basic stream geomorphology, and stream restoration design.

Prereq.: CEEN 3736 or permission of instructor.

CEEN 5836 Environmental Water Chemistry 3 s.h.

Fundamental principles and calculations of major chemical reactions and equilibria that occur in aquatic environments, and water/wastewater treatment processes.

Prereq.: CEEN 3736.

CEEN 5837 Environmental Engineering Design 3 s.h.

Theory and design of unit operations and processes for treatment of drinking water and municipal wastewater.

Prereq.: CEEN 3736.

CEEN 5849 Structural Analysis 2 3 s.h.

Analysis of statically indeterminate beams, trusses, bents and multistory frames, utilizing concepts of strain energy, virtual work, slope-deflection, and moment distribution. Introduction to matrix methods of analysis using force and displacement methods.

Prereq.: CEEN 3749.

CEEN 5855 Reinforced Concrete Design 3 s.h.

An introduction to the behavior, analysis, and design of reinforced concrete members. Included are singly and doubly reinforced beams, tee-beams, slabs, short and long columns.

Prereq.: CEEN 3749.

CEEN 5856 Steel Design 3 s.h.

An introduction to the behavior and design of steel structures. Included is the design of rolled and built-up tension members, beams, columns, beam-columns, welded and bolted connections.

Prereq.: CEEN 3749.

CEEN 5869 Design of Air Pollution Control Systems 3 s.h.

Engineering analysis, procedures, and techniques for the selection, applications and operation of air pollution control methods in various operational situations.

Prereq.: CEEN 3736.

CEEN 5877 Systems Engineering and Project Management 3 s.h.

Systems approach to engineering design; non-linear models; linear programming; dynamic programming; network analysis; project management.
Prereq.: MATH 3705.

CEEN 5879 Water Quality Modeling 3 s.h.

Mathematical modeling of physical, chemical, and biological processes in natural systems; development of computer models to simulate the fate and transport of pollutants in lakes, streams, and estuaries; application of models to evaluate water resource management options.
Prereq.: C or better in CEEN 3736.

CEEN 5880 Advanced Hydraulics 3 s.h.

Application of hydraulic principles for one dimensional river modeling; understanding the fundamental processes of open channel hydraulics; application of HEC-RAS/HEC-GeoRAS models for river system modeling.
Prereq.: A "C" or better in CEEN 3717.

CEEN 5882 Foundation Engineering 3 s.h.

Analysis and design of various foundations, including abutments, piers, piles, and footings; slope stability of embankments.
Prereq.: CEEN 4881 and CEEN 5855.

CEEN 5883 Bridge Engineering 3 s.h.

Analysis and design of concrete and steel bridges; specifications and code requirements; design detailing; effects of natural and man-made hazards on bridges; implications of bridge failures.
Prereq.: CEEN 5855 and CEEN 5856.

CEEN 5884 Solid and Hazardous Waste Management 3 s.h.

Sources, characteristics, handling and disposal options for solid waste and hazardous waste; topics include regulations, health effects, waste minimization, collection systems, landfill design, treatment and processing methods, and site assessment.
Prereq.: CEEN 3736.