CIVIL AND ENVIRONMENTAL ENGINEERING AND ENGINEERING MECHANICS

Major:

- Bachelor of Civil Engineering (p. 1)

Minors:

- Construction Engineering (p. 4) and Management (p. 4)
- Engineering Mechanics (p. 4)
- Environmental Engineering (p. 4)
- Geotechnical Engineering (p. 4)
- Structural Engineering (p. 5)
- Transportation Engineering (p. 5)
- Water Resources Engineering (p. 5)

The civil engineering profession is dedicated to improving and advancing the human condition throughout the world. Civil engineers apply creativity and problem-solving skills to provide safe, sustainable and healthy built environments for people and societies of the future. Civil engineers are widely employed throughout the public and private sector in traditional fields such as designing buildings, planning innovative transportation systems, advancing water supply and reuse technology, and preventing adverse environmental impacts on the earth and its people while simultaneously advancing the quality life. They may use their skills in projects located in developing countries where the need for their services is high.

Civil engineers are leaders in developing and using emerging technologies such as autonomous vehicles, virtual reality, and computer simulation. Civil engineers also enjoy rewarding careers in fields such as aerospace, power generation, oil and gas and other process industries. Their broad education successfully prepares them to enter the work force at the bachelor's level or they may pursue advanced studies. Most civil engineers obtain their professional licensure about four years after graduating.

The University of Dayton Department of Civil and Environmental Engineering and Engineering Mechanics offers a broad-based curriculum leading to a Bachelor of Civil Engineering (BCE) degree. The mission of the program is to graduate broadly educated, technically competent individuals prepared for professional careers or for advanced studies. Members of the student chapters of the American Society of Civil Engineers (ASCE), Institute of Transportation Engineers (ITE), and Structural Engineers Association of Ohio (SEAoO) have the opportunity to meet regularly with practicing engineers in the Dayton community.

Within the first several years following completion of the program, University of Dayton Bachelor of Civil Engineering graduates are prepared to meet the following program educational objectives:

- Achieve excellence in their civil engineering careers or other professions.
- Complete advanced degrees in support of their chosen profession.
- Lead and serve in their profession and community.
- Conduct their professional and personal endeavors in a responsible and ethical manner.
- Engage in professional, personal and spiritual development through life-long learning.

Faculty

Deogratias Eustace, Chairperson
Professors: Bilgin, Eustace, J. Saliba, Toubia
Associate Professors: Crosson, Whitney
Assistant Professor: Wang
Lecturers: Chase, Sawas

Bachelor of Civil Engineering (CEE) minimum 123 hours

The Common Academic Program (CAP) is an innovative curriculum that is the foundation of a University of Dayton education. It is a learning experience that is shared in common among all undergraduate students, regardless of their major. Some CAP requirements must be fulfilled by courses taken at UD. Some major requirements must also be fulfilled by courses taken at UD. Students should consult with their advisor regarding applicability of transfer credit to fulfill CAP and major program requirements.

Common Academic Program (CAP) [1]		
First-Year Humanities Commons [2]		6 cr. hrs.
HUM 101	Chaminade Seminar: Reading and Responding to the Signs of the Times	
HUM 102	Marie Thérèse Seminar: Human Dignity and the Common Good	
Second-Year Rhetoric and Writing		3 cr. hrs.
Arts		3 cr. hrs.
Mathematics		3 cr. hrs.
Natural Science [3]		4 cr. hrs.
Oral Communication		3 cr. hrs.
Social Science		3 cr. hrs.
Advanced Study		9 cr. hrs.
Historical Studies (3 cr. hrs.) [4]		
Philosophical Studies (3 cr. hrs.)		
Religious Studies (3 cr. hrs.) [5]		

Crossing Boundaries	9 cr. hrs.
Faith Traditions (3 cr. hrs.)	
Interdisciplinary Investigations (3 cr. hrs.) [4]	
Practical Ethical Action (3 cr. hrs.)	
Diversity and Social Justice [5, 6]	3 cr. hrs.
Major Capstone [7]	0-6 cr. hrs.
Experiential Learning [8]	0-3 cr. hrs.
Total Hours	**0-55**

1. The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student's degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.
2. May be completed with ASI 101 and ASI 102 through the Core Program. ASI 101 also fulfills CAP Arts and ASI 102 also fulfills CAP Second-Year Rhetoric and Writing.
3. Must include a lecture course and a lab.
4. U.S. History AP and CLEP credit will not satisfy this requirement.
5. Must be completed with a UD course or education abroad transfer credit; other types of transfer credit cannot be applied.
6. May not double count with First-Year Humanities Commons, Second-Year Rhetoric and Writing, Oral Communication, Social Science, or Natural Science CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student's major.
7. The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours. The Major Capstone CAP requirement must be completed with a UD course; transfer credit cannot be applied.
8. The course or experience will have variable credit, depending on the intensity and duration of the experience, or where it is housed in existing curricular and co-curricular spaces.

Major in Civil Engineering, BVE

MATHEMATICS AND SCIENCE REQUIREMENTS		
MTH 168	Analytic Geometry & Calculus I	4
MTH 169	Analytic Geometry & Calculus II	4
MTH 218	Analytic Geometry & Calculus III	4
MTH 219	Applied Differential Equations	3
CHM 123	General Chemistry I	3
CHM 123L	General Chemistry Laboratory	1
PHY 206	General Physics I - Mechanics	3
CORE CIVIL ENGINEERING COURSES		
EGR 102	Introduction to the University Experience for Engineers	0.5
EGR 103	Engineering Innovation	3
EGR 200	Career Launchpad: Preparing for Success	0.5
EGM 201	Mechanics I	3
EGM 202	Dynamics	3
EGM 303	Mechanics II	3
GEO 218	Geological Site Investigation for Engineers	3
Natural Science Electives (2 classes) Except ALL LABS and CHM 123, CHM 123L, CHM 1GF, CHM 1GFL, PHY 206, GEO 218 [1]		6
REQUIRED TECHNICAL COURSES		
CEE 213	Surveying	3
CEE 221L	Civil Computation Laboratory	2
CEE 311L	Civil Engineering Materials Laboratory	2
CEE 312	Geotechnical Engineering	3
CEE 312L	Geotechnical Engineering Laboratory	1
CEE 313	Hydraulics	3
CEE 313L	Hydraulics Laboratory	1
CEE 316	Analysis of Structures I	3
CEE 403	Transportation Engineering	3
CEE 412	Design of Concrete Structures	3
CEE 421	Construction Engineering	3
CEE 426	Risk and uncertainty analysis for infrastructures	3
CEE 427L	Civil Data Analytics	2
CEE 433	Water Resources Engineering	3
CEE 450	Civil Engineering Design	3
Focus Area		**15**
Choose from 1 of the following options:		
A. Infrastructure Option [3, 4]		
Infrastructure Core (You must complete all of the following:)		
CEE 411	Design of Steel Structures	
CEE 424	Foundation Engineering	
Infrastructure Electives (2 classes) [3, 4, 5]		
List of Approved Infrastructure Electives		
EGR 398	Multidisciplinary Research & Innovation Laboratory	
CEE 422	Design & Construction Project Management	
CEE 463/563/ CME 563	Hazardous Waste Engineering	
CEE 467	Sustainable Water and Waste Infrastructure	
CEE 493	Honors Thesis	
CEE 494	Honors Thesis	
CEE 498	Research & Innovation Laboratory [6]	
CEE 499	Special Problems in Civil Engineering	
CEE 500	Advanced Structural Analysis	
CEE 501	Structural Analysis by Computer	
CEE 502	Prestressed Concrete	
CEE 503	Introduction to Continuum Mechanics	
CEE 504	Structural Dynamics	
CEE 505	Plastic Design in Steel	
CEE 506	Design of Temporary Structures	
CEE 507	Masonry Design	
CEE 508	Design Timber Structures	
CEE 509	Bridge Engineering	
CEE 511	Experimental Stress Analysis	
CEE 515	Pavement Engineering	

CEE 520	Advanced Geotechnical Engineering
CEE 522	Subsurface Investigations
CEE 525	Soil Improvement
CEE 526	Retaining Structures & Slopes
CEE 528	Soil Dynamics & Earthquake Engineering
CEE 533	Theory of Elasticity
CEE 534	Theory of Plates & Shells
CEE 535	Advanced Mechanical Vibrations
CEE 539	Theory of Plasticity
CEE 540	Composites Design
CEE 541	Mechanics of Composite Materials
CEE 543	Analytical Mechanics Composite Materials
CEE 544	Mech-Composte Struc
CEE 546	Finite Element Analysis I
CEE 550	Highway Geometric Design
CEE 551	Traffic Engineering
CEE 552	Intelligent Transportation Systems
CEE 553	Travel Demand Modeling
CEE 554	Urban Public Transportation
CEE 555	Highway Traffic Safety
CEE 558	Traffic Engineering Research
CEE/CME 560	Biological Processes in Wastewater Engineering
CEE/CME 562	Physical & Chemical Water & Wastewater Treatment Processes
CEE 563	Hazardous Waste Engineering
CEE/CME 564	Solid Waste Engineering
CEE 580	Hydrology & Seepage
CEE 582	Advanced Hydraulics
CEE 584	Open Channel Flow
CEE 585	Advanced Open Channel Flow
CEE 595	Special Problems in Civil Engineering
B) Environmental Engineering option	
Environmental Core (You must complete all of the following:)	
CEE 434	Water & Wastewater Engineering
CEE 434L	Water & Wastewater Engineering Laboratory
Environmental Engineering Depth Electives (2 classes) [7]	
CEE 463	Hazardous Waste Engineering
CEE 467	Sustainable Water and Waste Infrastructure
CEE 493	Honors Thesis
CEE 494	Honors Thesis
CEE 498	Research & Innovation Laboratory [8]
CEE 499	Special Problems in Civil Engineering [8]
CEE 560	Biological Processes in Wastewater Engineering
CEE 562	Physical & Chemical Water & Wastewater Treatment Processes
CEE 563	Hazardous Waste Engineering
CEE 564	Solid Waste Engineering
CEE 574	Fundamentals of Air Pollution Engineering I
CEE 575	Fundamentals of Air Pollution Engineering II
CEE 576	Environmental Engineering Separation Processes
CEE 580	Hydrology & Seepage
CEE 582	Advanced Hydraulics
CEE 584	Open Channel Flow
CEE 585	Advanced Open Channel Flow
CME 560	Biological Processes in Wastewater Engineering
CME 562	Physical & Chemical Wastewater Treatment Processes
CME 563	Hazardous Waste Engineering
CME 564	Solid Waste Engineering
CME 574	Fundamentals of Air Pollution Engineering I
CME 575	Fundamentals of Air Pollution Engineering II
CME 576	Environmental Engineering Separation Processes
Breadth Electives (1 class) [9]	
SEE 250	Introduction to Sustainability, Energy & the Environment
SEE 301	Earth Systems & Global Climate Change
SEE 310	Sustainability Scenarios
SEE 323	Cities and Energy
SEE 401	Sustainability Project Management
SEE 402	Community-Engaged Sustainability
BIO 359	Sustainability & the Biosphere
BIO 395	Global Environmental Biology
BIO 409	Ecological Restoration
BIO 444	Plant Diversity
BIO 459	Environmental Ecology
CHM 313	Organic Chemistry
CHM 314	Organic Chemistry
CHM 341	Environmental Chemistry
GEO 301	Structural Geology
GEO 303	Field Geology
GEO 402	Glacial Geology
GEO 407	Sculpted Planet: Geomorphology, Surface Processes, and the Origins of Earth's Topography
GEO 409	Surface & Groundwater Hydrology
GIS 450	Applied Geographic Information Systems
GIS 455	Environmental Remote Sensing
GIS 560	Advanced Applications of Geographical Information Systems
GIS 598	GIS Capstone
EGM 504	Fundamentals of Fluid Mechanics
EGR 330	Engineering Design & Appropriate Technology
ENM 505	Systems Engineering Fundamentals
ENM 506	Engr Mngmt & Society
ENM 517	Legal Aspects of Engineering
ENM 530	Engineering Economy
MEE 473	Renewable Energy Systems
Total Hours	**97**

1 Natural science electives may be taken at any level from BIO, CHM, GEO, PHY. Except ALL LABS and CHM 123, CHM 123L, CHM 1GF, CHM 1GFL, PHY 206, GEO 218

2 Admittance into CEE 450 requires successful completion of least any two of the following: CEE 403, CEE 411, CEE 412, CEE 424, CEE 433, CEE 434. Students must enroll in CEE 452L during their last undergraduate semester.

[3] Select from list approved by the Department of Civil and Environmental Engineering and Engineering Mechanics.

[4] May be used to concentrate studies in the areas of construction, environmental, geotechnical, structural, transportation, and water resources engineering.

[5] EGR 398 must be 3 credit hours and taught or coordinated by a CEE faculty member to count as a civil engineering elective.

[6] CEE 498 must be 3 credit hours to count as a civil engineering elective.

[7] CEE 595 Special Problems in Civil Engineering with environmental focus may be accepted, subject to departmental approval.

[8] Course must be 3 credit hours and taught or coordinated by a CEE water resources or water quality faculty member to count as a depth elective for the environmental engineering option.

[9] Breadth electives may not double count with Natural Science electives.

Minor in Construction Engineering and Management (CEM)

This minor is open to all majors. The program provides broad coverage of the general concepts of construction engineering and management as applied to all types of construction projects.

Select four courses from: [1]		12
CEE 421	Construction Engineering	
CEE 514	Design & Construction Project Management	
CEE 516	Managing Construction Field Operations	
CEE 517	Management of Construction Organization	
CEE 518	Procurement & Contract Management for Construction Projects	
CEE 519	Risk Management for Construction Projects	
Total Hours		12

[1] Only one course may double count for both the student's major and minor.

Minor in Engineering Mechanics (EME)

This minor is open to all engineering majors. The program provides a broad treatment of engineering mechanics including theoretical, numerical, and experimental topics.

Select four courses from: [1]		12
CEE 540	Composites Design	
or EGM 540	Composite Design	
EGM 303	Mechanics II	
EGM 503	Introduction to Continuum Mechanics	
EGM 511	Experimental Stress Analysis	
EGM 533	Theory of Elasticity	
EGM 546	Finite Element Analysis I	
MAT 540	Composite Design	
MEE 504	Fundamentals of Fluid Mechanics	
Total Hours		**12**

[1] Only one course may double count for both the student's major and minor.

Minor in Environmental Engineering (EVE)

This minor is open to all engineering majors. The program defines contemporary problems of pollution and identifies the technological approaches necessary to preserve the quality of our environment.

Select four courses from: [1, 2, 3]		12
CEE 434	Water & Wastewater Engineering	
CEE 467	Sustainable Water and Waste Infrastructure	
CEE 560	Biological Processes in Wastewater Engineering	
or CME 560	Biological Processes in Wastewater Engineering	
CEE/CME 562	Physical & Chemical Water & Wastewater Treatment Processes	
CEE/CME 563	Hazardous Waste Engineering	
or CEE 463	Hazardous Waste Engineering	
CEE 564	Solid Waste Engineering	
CEE 574	Fundamentals of Air Pollution Engineering I	
CEE 575	Fundamentals of Air Pollution Engineering II	
or CME 575	Fundamentals of Air Pollution Engineering II	
CEE 576	Environmental Engineering Separation Processes	
CHM 341	Environmental Chemistry	
Total Hours		**12**

[1] Only one course may double count for both the student's major and minor. It is recommended the minor include one course pertaining to water, air, and solid pollution control.

[2] Other special project courses with an environmental engineering focus can be substituted, subject to departmental approval. These include CEE 499, 590, CEE 595 , and EGR 330.

[3] No more than three credit hours of EGR 330, CEE 499, or other special project coursework may be applied to this minor.

Minor in Geotechnical Engineering (GTC)

This minor is open to all engineering majors. The program provides a broad coverage on the design and analysis concepts related to the geotechnical engineering fundamentals.

Select four courses from: [1]		12
CEE 312	Geotechnical Engineering	
CEE 520	Advanced Geotechnical Engineering	
CEE 522	Subsurface Investigations	
CEE 524	Foundation Engineering	
CEE 525	Soil Improvement	
CEE 526	Retaining Structures & Slopes	
CEE 528	Soil Dynamics & Earthquake Engineering	
CEE 595	Special Problems in Civil Engineering	
Total Hours		**12**

[1] Only one course may double count for both the student's major and minor.

Minor in Structural Engineering (STR)

This minor is open to all engineering majors. The program provides a broad coverage of general concepts of structural design as applied to buildings, bridges, aerospace structures, mechanical systems and machinery.

Select four courses from: [1]		12
CEE 316	Analysis of Structures I	
CEE 411	Design of Steel Structures	
CEE 412	Design of Concrete Structures	
CEE 500	Advanced Structural Analysis	
CEE 501	Structural Analysis by Computer	
CEE 502	Prestressed Concrete	
CEE 504	Structural Dynamics	
CEE 505	Plastic Design in Steel	
CEE 506	Design of Temporary Structures	
CEE 507	Masonry Design	
CEE 508	Design Timber Structures	
CEE 509	Bridge Engineering	
CEE 524	Foundation Engineering	
CEE 540	Composites Design	
CEE 595	Special Problems in Civil Engineering [2]	
Total Hours		**12**

1 Only one course may double count for both the student's major and minor.

2 Course topic: Bridge Engineering

Minor in Transportation Engineering (TRE)

This minor is open to all majors. The program provides broad coverage in the planning, design, operations, and management of transportation systems.

Select four courses from: [1]		12
CEE 403	Transportation Engineering	
CEE 515	Pavement Engineering	
CEE 550	Highway Geometric Design	
CEE 551	Traffic Engineering	
CEE 552	Intelligent Transportation Systems	
CEE 553	Travel Demand Modeling	
CEE 554	Urban Public Transportation	
CEE 555	Highway Traffic Safety	
CEE 558	Traffic Engineering Research	
CEE 595	Special Problems in Civil Engineering	
Total Hours		**12**

1 Only one course may double count for both the student's major and minor.

[1] Courses selected may not be those already required for student's major.

Minor in Water Resources Engineering (WRE)

This minor is open to all engineering majors. The program provides broad coverage of the general concepts used in water resources engineering including hydraulics and hydrology issues within economic, optimization, operation, and management frameworks.

Select four courses from: [1]		12
CEE 313	Hydraulics	
CEE 333	Water Resources Engineering	
CEE 580	Hydrology & Seepage	
CEE 582	Advanced Hydraulics	
CEE 584	Open Channel Flow	
CEE 585	Advanced Open Channel Flow	
CEE 595	Special Problems in Civil Engineering	
GIS 450	Applied Geographic Information Systems [2]	
GIS 550	Applied Geographic Information Systems [2]	
Total Hours		**12**

1 Only one course may double count for both the student's major and minor.

2 Either GIS 450 or GIS 550 may count towards the minor.

INFRASTRUCTURE TRACK

First Year

Fall	Hours	Spring	Hours
HUM 101	3	HUM 102	3
CAP Social Science (may also satisfy additional CAP components)	3	CAP ARTS (may also satisfy additional CAP components)	3
PHY 206 or PHYS 206 (Satisfies CAP Natural Science)	3	GEO 218	3
MTH 168 (Satisfies CAP Math Requirement)	4	MTH 169	4
EGR 103	3	EGM 201	3
EGR 102	0.5		
	16.5		**16**

Second Year

Fall	Hours	Spring	Hours
ENG 200	3	CHM 123	3
MTH 218	4	CHM 123L	1
EGM 202	3	MTH 219	3
CEE 213	3	EGM 303	3
CEE 221L	3	CEE 311L	3
EGR 200	0.5		
	16.5		**13**

Third Year

Fall	Hours	Spring	Hours
CEE Natural Science Elective (BIO, CHM, GEO, PHY/PHYS)	3	CAP Advanced Religious Studies (may also satisfy additional CAP components)	3
CEE 313	3	CEE 312	3
CEE 313L	1	CEE 312L	1

CEE 316	3	CEE 412	3
CEE 421	3	CEE 427L	3
CEE 426	3	CEE 433	3
	16		**16**

Fourth Year

Fall	Hours	Spring	Hours
CAP Advanced History (may also satisfy additional CAP components)	3	CAP Advanced Philosophy (may also satisfy additional CAP components)	3
CEE 411	3	CEE Natural Science Elective (BIO, CHM, GEO, PHY)	3
CEE 424	3	CEE 450	3
CEE 403	3	CEE Infrastructure Elective	3
CEE Infrastructure Elective	3		
	15		**12**

Total credit hours: 121

ENVIRONMENTAL ENGINEERING TRACK

First Year

Fall	Hours	Spring	Hours
HUM 101	3	HUM 102	3
CAP Social Science (may also satisfy additional CAP components)	3	CAP ARTS (may also satisfy additional CAP components)	3
PHY 206 or PHYS 206 (Satisfies CAP Natural Science)	3	GEO 218	3
MTH 168 (Satisfies CAP Math Requirement)	4	MTH 169	4
EGR 103	3	EGM 201	3
EGR 102	0.5		
	16.5		**16**

Second Year

Fall	Hours	Spring	Hours
ENG 200	3	CHM 123	3
MTH 218	4	CHM 123L	1
EGM 202	3	MTH 219	3
CEE 213	3	EGM 303	3
CEE 221L	3	CEE 311L	3
EGR 200	0.5		
	16.5		**13**

Third Year

Fall	Hours	Spring	Hours
CEE Natural Science Elective (BIO, CHM, GEO, PHY/PHYS)	3	CAP Advanced Philosophy (may also satisfy additional CAP components)	3
CEE 313	3	CEE 312	3
CEE 313L	1	CEE 312L	1
CEE 316	3	CEE 433	3
CEE 421	3	CEE 412	3
CEE 426	3	CEE 427L	3
	16		**16**

Fourth Year

Fall	Hours	Spring	Hours
CEE 403	3	CAP Advanced Religious Studies (may also satisfy additional CAP components)	3
CEE 434	3	CAP Advanced History (may also satisfy additional CAP components)	3
CEE 434L	1	CEE Natural Science Elective (BIO, CHM, GEO, PHY)	3
CEE Environmental Breadth Elective	3	CEE Environmental Depth Elective	3
CEE Environmental Depth Elective	3	CEE 450	3
	13		**15**

Total credit hours: 122

Civil & Environmental Engr Courses

CEE 101. Introduction to Civil Engineering. 0-1 Hours
Introduction to the civil engineering faculty, facilities, and curriculum; to the career opportunities offered by the civil engineering profession; and to the areas of specialization within civil engineering.

CEE 198. Research & Innovation Laboratory. 1-6 Hours
Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

CEE 213. Surveying. 3 Hours
An introduction to surveying and geomatics, with emphasis to theory of measurements and computation errors, leveling and traverse computations. topographic surveys, computations of earthwork, slope staking and stake out of highway curves. First term, each year. Prerequisite(s): MTH 168.

CEE 221L. Civil Computation Laboratory. 3 Hours
Introduction to numerical methods and logical problem solving techniques commonly used in the civil engineering profession. Introduction to computer aided drawing and design and the use of popular CADD packages in the civil engineering profession.

CEE 298. Research & Innovation Laboratory. 1-6 Hours
Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

CEE 300. Professional Development Seminar. 0 Hours
Practice in the presentation and discussion of papers; lectures by staff and prominent engineers. Attendance required of all civil engineering juniors.

CEE 311L. Civil Engineering Materials Laboratory. 3 Hours
Laboratory experiments in the physical and mechanical properties of construction materials; Portland cement concrete, bituminous materials, wood, ferrous and non-ferrous metals, and masonry units; proportioning of concrete mixtures including admixtures. Pre/Corequisite(s): EGM 303.

CEE 312. Geotechnical Engineering. 3 Hours
Principles of soil structures, classification, capillarity, permeability, flow nets, shear strength, consolidation, stress analysis, slope stability, lateral pressure, bearing capacity, and piles. Second term, each year. Prerequisite(s): EGM 303. Corequisite(s): GEO 218.

CEE 312L. Geotechnical Engineering Laboratory. 1 Hour
Laboratory tests to evaluate and identify soil properties for engineering purposes. Design problems are also included. Second term, each year. Corequisite(s): CEE 312.

CEE 313. Hydraulics. 3 Hours
Basic principles of fluid mechanics in closed conduits and open channels. Principles include fluid statics, conservation of mass, conservation of momentum, conservation of energy, and fluid dynamics. Presentation of fluid mechanics principles through the solution of practical problems and a comprehensive semester project. Prerequisites: EGM 202. Corequisites: CEE 313L.

CEE 313L. Hydraulics Laboratory. 1 Hour
Laboratory experiments and problems associated with CEE 313. Corequisite(s): CEE 313.

CEE 316. Analysis of Structures I. 3 Hours
Elastic analysis of structures; deflection, moment-area theorems; conjugate-beam; virtual work influence lines; analysis of indeterminate structures using force methods; theories of failure, stiffness matrices, and use of software to analyze structures. Prerequisite(s): EGM 303.

CEE 333. Water Resources Engineering. 3 Hours
Integrated study of the principles of water movement and management. Focus areas include hydrology, water distribution, storm water management, and waste water collection. Second semester, each year. Prerequisite(s): CEE 313.

CEE 398. Research & Innovation Laboratory. 1-6 Hours
Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

CEE 400. Professional Development Seminar. 0 Hours
Practice in the presentation and discussion of papers; lectures by staff and prominent engineers. Attendance required of all civil engineering seniors. Prerequisites: CEE 300 or COP 101.

CEE 403. Transportation Engineering. 3 Hours
Fundamentals of transportation engineering, including design, construction, maintenance, and economics of transportation facilities. Design of pavement structures and drainage systems. Prerequisites: Junior or senior status and CEE 213.

CEE 406. Design of Temporary Structures. 3 Hours
Design and analysis of temporary structures including loading, shoring, formwork, falsework, scaffolding, ground support systems, bracing, soldier beam and lagging, sheet piling, equipment bridges, and support of existing structures. Required background: Analysis of Structures.

CEE 409. Bridge Engineering. 3 Hours
Introduction to bridge design and analysis of short and medium-span bridges using the Load and resistance Factor Design (LRFD) philosophy. Study of bridge design loads, influence lines, and design of bridge substructure and superstructure using reinforced and prestressed concrete elements as well as steel and composite steel deck girders. Prerequisite(s): CEE 316. Pre/Corequisite(s): CEE 411, CEE 412.

CEE 411. Design of Steel Structures. 3 Hours
Design and behavior of structural steel connections, columns, beams, and beams subjected to tension, compression, bending, shear, torsion, and composite action. Second semester, each year. Prerequisite(s): CEE 311L and CEE 316.

CEE 412. Design of Concrete Structures. 3 Hours
Design and behavior of reinforced concrete slabs, beams, columns, walls, and footings subjected to tension, compression, bending, shear, and torsion. First semester, each year. Pre/corequsities: CEE 312. Prerequisites: CEE 311L; CEE 316.

CEE 421. Construction Engineering. 3 Hours
Organization, planning, and control of construction projects, including a study of the use of machinery, methods, materials, estimates, cost controls, and fundamentals of CPM and PERT. Contracts and bonds and legal aspects of contracting. Engineering economics including present and annual worth analysis, evaluation of alternatives.

CEE 422. Design & Construction Project Management. 3 Hours
Fundamentals of project management as they relate to the design and construction professional, and the application of project management techniques to the design and construction of major projects. Departmental elective.

CEE 424. Foundation Engineering. 3 Hours
Review of soil properties, site exploration and evaluation, bearing capacity, settlements, shallow foundations, retaining structures, and deep foundations. Prerequisite(s): CEE 312.

CEE 426. Risk and uncertainty analysis for infrastructures. 3 Hours
Study of the principles of reliability, risk, and uncertainty quantification for infrastructures. It covers the methodologies for modeling risk and uncertainty in engineering practices and the analysis of its effects on infrastructure design, operation, and maintenance. Prerequisites: MTH 169.

CEE 427L. Civil Data Analytics. 3 Hours
An introduction to data analytics most commonly used to preprocess, process, analyze, and visualize data in the context of civil engineering problems. Topics include various types of civil engineering testing, monitoring, and inspection data, methods for statistical inference and parameter estimation from observed data, linear regression, correlation analysis, classification and clustering analysis, and results visualization. Prerequisites: MTH 169; CEE 426.

CEE 430. Introduction to Environmental Engineering. 1 Hour
This is an introductory course for civil engineering students in the non-environmental track to gain a basic understanding of the physical, chemical, and biological processes of water and wastewater treatment. Prerequisites: CHM 123; CHM 123L.

CEE 433. Water Resources Engineering. 3 Hours
Integrated study of the principles of water movement and management. Focus areas include hydrology, water distribution, storm water management, and waste water collection. Second semester, each year. Prerequisites: CEE 313.

CEE 434. Water & Wastewater Engineering. 3 Hours
Problems of water pollution; development and design of public water supply and waste water treatment systems; legal, political, ethical, and moral considerations. First term, each year. Prerequisites: CHM 123. Corequisites: CEE 313, CEE 434L.

CEE 434L. Water & Wastewater Engineering Laboratory. 1 Hour
Laboratory exercises, demonstrations, and design problems associated with water and wastewater engineering. First semester, each year. Prerequisite(s): CHM 123L. Corequisite(s): CEE 434.

CEE 450. Civil Engineering Design. 3 Hours
A small group (3-5 people) design of a complete, large-scale civil engineering system. The capstone design experience draws upon knowledge acquired over a wide spectrum of civil engineering subjects including environmental, geotechnical, structural, transportation and water resources engineering as well as project management. Second semester, each year. Prerequisite(s): CEE 333 or CEE 433, CEE 403, CEE 411, CEE 412, CEE 424, CEE 434. Student may take any 2 out of these 6 courses to meet the prerequisite needed for CEE 450; This is changed from the previous requirement of 4 out of these 6 courses needed prior to taking CEE 450.

CEE 451L. Capstone Design I. 2 Hours
This course is the first course in a two-course sequence that culminates the major engineering design experience in the Civil Engineering program. Students will participate in civil engineering projects; incorporate appropriate engineering standards and codes; and will address multiple realistic constraints including, but not limited to, economic, environmental and societal constraints. This is accomplished within a framework where they integrate their previously acquired fundamental engineering knowledge and benefit from guidance provided by mentors who are practicing civil engineers from industry. Students form multidisciplinary design teams, work on real-world civil engineering projects, develop multiple conceptual design solutions, and prepare a draft technical report, which includes a detailed scope of work, a poster, and an oral presentation. Prerequisites: Senior standing and have completed one area of specialty from the six civil engineering specialty areas shown below: Construction (CEE 421), Transportation (CEE 403), Geotechnical (CEE 424), Water Resources (CEE 333), Environmental (CEE 434), Structures (CEE 411 or CEE 412). Corequisites: Concurrently taking a minimum of two courses from the reminder of the six specialty areas shown above, and pursuing courses in the selected CEE or SEE minor or one approved by the chair of CEE advisor.

CEE 452L. Capstone Design II. 2 Hours
This course is the second course in a two-course sequence that culminates the major engineering design experience in the Civil Engineering Program. Students will build on the work they completed in CEE 451. Teams will finalize design solutions, evaluate cost, study constructability, and consider the safety, public health, social, environmental, and sustainable impacts of their designs. Each student will evaluate their solutions against requirements, considering risks, and making trade- offs, for the purpose of obtaining a high-quality solution under the given circumstances. An oral presentation, technical report, and technical drawings documenting the students' solution is required at the completion of the project. The primary goal of CEE 452 is to replicate the same design experience that students will encounter when they enter the workforce. Prerequisites: CEE 451L. Corequisites: Attempting the remaining courses in the selected CEE or SEE minor or one approved by the chair of CEE.

CEE 463. Hazardous Waste Engineering. 3 Hours
The fundamental principles of the design and operation of hazardous waste control and hazardous substances remediation processes. Hazardous waste regulations, risk assessment, and management. Prerequisite(s): CHM 123.

CEE 467. Sustainable Water and Waste Infrastructure. 3 Hours
Study of current issues and emerging approaches to provide sustainable municipal water and waste management. Includes evaluation of equitable access to these services and consequences from these practices. Prerequisite(s): (CHM 123 or ECO 203) and (MTH 129 or MTH 138 or MTH 148 or MTH 168).

CEE 484. Open Channel Flow. 3 Hours
Open channel flow in its various forms will be studied. Major topics to be covered include energy and momentum principles, uniform and gradually varied flow. This course will concentrate on one-dimensional steady-state flow with an emphasis on the use of widely-used computer simulation models to determine water surface profiles and to examine flooding in urban areas. Erodible and non-erodible channel design is also covered.

CEE 493. Honors Thesis. 3 Hours
Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program.

CEE 494. Honors Thesis. 3 Hours
Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program. Prerequisite(s): CEE 493.

CEE 498. Research & Innovation Laboratory. 1-6 Hours
Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered.

CEE 499. Special Problems in Civil Engineering. 1-6 Hours
Particular assignments to be arranged and approved by chairperson of the department. Departmental elective.

Engineering Mechanics Courses

EGM 201. Mechanics I. 3 Hours
This course provides an introduction to mechanics as applied to engineering problems. Principles of force and moment balance are applied to systems in static equilibrium. Students are introduced to the concepts of free-body diagrams and equivalent systems of forces, properties of areas and sections, analysis of simple structures, and internal forces. Introduces a common problem-solving approach and processes to address and solve problems and creative application of theory. This course is part of the Integrated Engineering Core for all engineering students. Prerequisites: PHY 206 and MTH 168.

EGM 202. Dynamics. 3 Hours
Kinematics, including translation, rotation, plane motion, and relative motion; kinetics of particles and bodies by the methods of force-mass-acceleration, work-energy, and impulse-momentum. Each semester, each year. Prerequisite(s): EGM 201 or EGR 201.

EGM 303. Mechanics II. 3 Hours
The study of stresses, strains, and deflections in tension, compression, shear, flexure, and torsion; shear and moment diagrams; analysis of stresses and strains at a point; Mohr's circle; analysis of columns. Each semester, each year. Prerequisites: EGM 201 or EGR 201.

EGM 499. Special Problems in Engineering Mechanics. 1-6 Hours
Particular assignments to be arranged and approved by chairperson of the department.