

Civil Engineering, MS

Chairperson: Daniel Zitomer, Ph.D., P.E.

Civil Engineering Graduate Programs website (http://www.marquette.edu/engineering/civil_environmental/grad.shtml/)

Degree Offered

Master of Science

Mission Statement

The mission of the Department of Civil, Construction and Environmental Engineering is to educate students in the Catholic, Jesuit tradition. These students will be competent in their technical fields, appreciate the moral and ethical impact of their professional work, and continue their professional development throughout their careers. They will advance the state of technical and scientific knowledge through research and provide service to civic and professional communities.

Program Descriptions

The Department of Civil, Construction and Environmental Engineering offers master of science and doctor of philosophy degree programs (<https://www.marquette.edu/grad/programs-civil-engineering.php>) designed to provide graduate students with both broad fundamental knowledge and up-to-date information on current and emerging technologies. Students may enroll on either a full-time or part-time basis. Doctoral students and research-oriented master's students (e.g., Plan A) engage in research activities under the close supervision of their advisers, gradually learning to become independent researchers. Their projects are often supported by government and industry grants. Courses and research projects make significant use of the department's extensive laboratory and computational facilities. Graduates find employment in industry, government, academia and research laboratories.

The Department also offers a graduate certificate in environmental engineering, designed for practicing professionals. Students typically enroll on a part-time basis. The environmental engineering certificate is designed to develop graduates with the skills required to solve complex environmental engineering problems in order to protect public health and the environment. The certificate will offer students the opportunity to explore a greater technical understanding of problems associated with air, land, and water resources in both urban and rural communities. Graduates of this program are likely to find positions in a wide range of organizations including governmental agencies, municipal engineering departments, consulting engineer companies, construction companies, as well as a wide range of industries.

The Department participates in the Opus College of Engineering's Master's Across Boundaries (MAB) program. Under this initiative, applicants to the master of science in civil engineering program may be permitted by the department to apply up to two previously earned MAB graduate certificates (up to 12 credits each) toward the M.S. Plan B degree. All program criteria for the M.S. degree (Plan B) must still be met. (See the section on Civil Engineering Master's Requirements.) Applicants who are admitted to the M.S. program with previously earned MAB certificate(s) will be informed at the time of admission which of their certificate course work may be applied toward the M.S. Plan B degree. Additional details on the application of specific certificates toward the specific specializations of the M.S. degree may be found at the end of this section.

Research Activities

The Department of Civil, Construction and Environmental Engineering maintains laboratories related to studies in construction engineering, hydraulics, environmental engineering, engineering materials and structural testing, as well as computational facilities. The Construction Automation Laboratory, Engineering Materials and Structural Testing Laboratory, Transportation Research Center and Water Quality Center are associated with the department.

Research interests of the faculty include the following, listed by specialization:

Construction Engineering (CNEN): advanced technology applications in construction, lean construction practices, management of construction processes, modeling of construction projects, virtual design and construction, bridge repair and replacement, on-site productivity measurement and improvement, highway work-zone safety and international construction management;

Environmental and Water Resources Engineering (ENWR): anaerobic biotechnology, wastewater treatment, analytical chemistry, physical/chemical water treatment, fate and impacts of emerging contaminants, antibiotic resistance, pyrolysis, nutrient recovery, environmental microbiology, advanced oxidation processes, sustainability and life-cycle cost analysis, hydrologic modeling, green stormwater infrastructure, geographic information systems, flood frequency analysis, real-time control of stormwater systems;

Structural Engineering and Structural Mechanics (SESM): retrofit and repair of structures using fiber-reinforced polymers, prestressed concrete, reliability-based performance assessment of civil infrastructure, health monitoring of civil infrastructure, performance-based engineering, ground motion simulation validation, climate change mitigation and adaptation, sustainable and resilient infrastructure, structural mechanics modeling of micro-structures for chemical/biosensing and energy-harvesting applications;

Transportation Engineering and Materials (TEMA): transportation systems operations and maintenance (TSM&O), data analysis and visualization, health care access, smart communities, pavement mechanics, modeling of flexible and rigid pavements, tire-pavement interaction, micromechanical modeling of asphalt concrete, pavement damage.

Civil Engineering Master of Science

Specializations: Construction Engineering (CNEN), Environmental and Water Resources Engineering (ENWR), Structural Engineering and Structural Mechanics (SESM), Transportation Engineering and Materials (TEMA)

Upon enrolling in the master of science program in civil engineering, a student may complete a general course of study or select one of four areas of specialization: construction engineering (CNEN), environmental and water resources engineering (ENWR), structural engineering and structural mechanics (SESM), or transportation engineering and materials (TEMA).

During the first term, a Master's Program Planning Form (MPPF) should be completed by the student in consultation with the student's faculty adviser, thereby enabling the student to declare the Plan A (thesis) or Plan B (non-thesis, i.e., course work) option, while also ensuring that the student is aware of the master's degree requirements for the option chosen.

If Plan A is chosen, the student and faculty adviser should discuss plans for thesis research during the first or second term of study. After the thesis topic is defined, the student should submit a thesis outline that is approved by the entire thesis committee. This document serves as an agreement between the student and the committee regarding the expectations of the thesis content, including the motivation, objectives and scope of the proposed study. The outline should also place the proposed work within the context of other related studies. Toward the final phase of performing the thesis research and writing the thesis, a Plan A student should consult with the faculty adviser to schedule the thesis defense. The defense typically occurs during the final term of the M.S. program before a three-person M.S. thesis committee. If Plan B is chosen, the student should consult with the faculty adviser during the final term of the program to schedule the M.S. comprehensive exam. The comprehensive exam for a Plan B student is usually an oral exam, administered by a two- or three-person faculty committee. The scope of the Plan B comprehensive exam may span the student's entire body of course work. Regardless of the plan chosen, the master of science program is designed specifically to meet the goals of the individual student.

Thesis Option (Plan A)

The academic requirements for the thesis option (Plan A) of the master of science in civil engineering are the following:

- A minimum of 24 credit hours of course work at the graduate level (5000 or above).
- A minimum of 12 credit hours of course work must be at the 6000 level or above.
- A minimum of 18 credit hours of the total course work must be taken from the course offerings of the Department of Civil, Construction and Environmental Engineering.
- For those students who have declared a specialization, a minimum of 12 credit hours must be taken from a list of approved courses within the specialization. (See the appropriate table below.)
- Six (6) credit hours of thesis work, completion of an oral thesis defense/comprehensive exam and submission of an approved thesis.
- Normally, no more than six (6) credit hours of Independent Study course work (CEEN 6995) can be included in the master of science program.
- A maximum of nine (9) credit hours of graduate-level course work from other approved institutions may be accepted toward the requirements of the degree, provided that all conditions of the Marquette University Graduate School's transfer credit policy are met.
- A maximum of 12 credit hours of graduate-level course work from a Marquette University graduate certificate program in a related area may be accepted toward the requirements of the master of science degree in civil engineering, provided that all conditions of the Marquette University Graduate School's transfer credit policy are met.
- All graduate students must maintain a 3.000 cumulative GPA to graduate. Determination of the cumulative GPA is based on *all* courses taken at Marquette University during a student's graduate career, including prerequisite and repeated courses, if any.

Non-Thesis (Course Work) Option (Plan B)

The academic requirements for the non-thesis (course work) option (Plan B) of the master of science in civil engineering are the following:

- A minimum of 30 credit hours of course work at the graduate level (5000 or above).
- A minimum of 12 credit hours of course work must be at the 6000 level or above.
- A minimum of 18 credit hours of the total course work must be taken from the course offerings of the Department of Civil, Construction and Environmental Engineering.
- For those students who have declared a specialization, a minimum of 12 credit hours must be taken from a list of approved courses within the specialization. (See the appropriate table below.)
- Successful completion of an oral comprehensive examination, usually administered during the final semester of the program. Scheduling of the exam is performed by the student in consultation with the student's faculty adviser.
- Normally, no more than six (6) credit hours of Independent Study course work (CEEN 6995) can be included in the master of science program.
- A maximum of nine (9) credit hours of graduate-level course work from other approved institutions may be accepted toward the requirements of the degree, provided that all conditions of the Marquette University Graduate School's transfer-credit policy are met.

- A maximum of 24 credit hours of graduate-level course work from a maximum of two Marquette University graduate certificate programs in appropriate areas may be applied toward the requirements of the master of science degree in civil engineering, provided that all conditions of the Marquette University Graduate School's transfer credit policy are met.
- All graduate students must maintain a 3.000 cumulative GPA to graduate. Determination of the cumulative GPA is based on *all* courses taken at Marquette University during a student's graduate career, including prerequisite and repeated courses, if any.

Plan A Course Requirements

If no specialization is chosen, Plan A students must complete:

Code	Title	Hours
Required course work (24 credit hours) chosen from the following:		24
CEEN 5145	Advanced Strength and Applied Stress Analysis	
CEEN 5230	Urban Hydrology and Stormwater Management	
CEEN 5310	Geographical Information Systems in Engineering and Planning	
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5350	Law for Engineers	
CEEN 5411	Matrix Structural Analysis	
CEEN 5431	Advanced Structural Steel Design	
CEEN 5441	Advanced Reinforced Concrete Design	
CEEN 5450	Bridge Design	
CEEN 5515	Environmental Chemistry	
CEEN 5520	Industrial Wastewater Management	
CEEN 5525	Treatment Plant Design and Operation	
CEEN 5530	Hazardous and Industrial Waste Management	
CEEN 5535	Environmental Engineering Microbiology	
CEEN 5550	Water Resources Planning and Management	
CEEN 5615	Highway Planning and Design	
CEEN 5640	Traffic Characteristics and Design	
CEEN 5650	Pavement Design	
CEEN 5660	Pavement Management	
CEEN 5670	Advanced Transportation Materials	
CEEN 5715	Sustainable Engineering	
CEEN 5815	Mechanical and Electrical Systems for Buildings	
CEEN 5830	Construction Planning, Scheduling, and Control	
CEEN 5840	Construction Cost Analysis and Estimating	
CEEN 5845	Construction Equipment and Methods	
CEEN 5850	FRP in Civil Engineering Infrastructure	
CEEN 5931	Topics in Civil Engineering	
CEEN 6110	Theory of Elasticity	
CEEN 6120	Introduction to the Finite Element Method	
CEEN 6121	Applied Finite Element Analysis and Modeling	
CEEN 6340	Advanced Hydrology	
CEEN 6350	Introduction to Environmental Systems Modeling	
CEEN 6410	Numerical Analysis with Structural Application	
CEEN 6420	Nonlinear Structural Analysis	
CEEN 6425	Earthquake Engineering	
CEEN 6435	Structural Dynamics	
CEEN 6460	Engineering Reliability	
CEEN 6470	Performance-Based Engineering	
CEEN 6510	Biotechnology for Wastewater Management	
CEEN 6520	Environmental Laboratory 1 - Analyses	
CEEN 6521	Environmental Laboratory 2 - Processes	
CEEN 6540	Physical and Chemical Processes of Environmental Engineering	

CEEN 6560	Fate of Micropollutants	
CEEN 6610	Advanced Traffic Operations Analysis and Design	
CEEN 6620	Urban Facility Design	
CEEN 6635	Highway Interchange Design	
CEEN 6650	Bituminous Materials	
CEEN 6655	Transportation Soils	
CEEN 6660	Advanced Pavement Design	
CEEN 6840	Infrastructure Information Modeling	
CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6953	Graduate Seminar in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
GEEN 6730	Project Management	
Additional courses as approved by adviser and the CCEE director of graduate studies		
CEEN 6999	Master's Thesis	6
M.S. Thesis Defense and Submission of Approved Thesis		0
Total Credit Hours:		30

For the Construction Engineering (CNEN) specialization, Plan A students must complete:

Code	Title	Hours
Required specialization course work (12 credits minimum) chosen from the following:		12
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5350	Law for Engineers	
CEEN 5660	Pavement Management	
CEEN 5815	Mechanical and Electrical Systems for Buildings	
CEEN 5830	Construction Planning, Scheduling, and Control	
CEEN 5840	Construction Cost Analysis and Estimating	
CEEN 5845	Construction Equipment and Methods	
CEEN 5931	Topics in Civil Engineering (CNEN) ¹	
CEEN 6460	Engineering Reliability	
CEEN 6840	Infrastructure Information Modeling	
CEEN 6932	Advanced Topics in Civil Engineering (CNEN) ¹	
CEEN 6995	Independent Study in Civil Engineering (CNEN) ¹	
GEEN 6730	Project Management	
Additional courses within the specialization as approved by adviser and the CCEE director of graduate studies		
Remaining courses chosen from the following or from the list above:		12
CEEN 5715	Sustainable Engineering	
CEEN 5931	Topics in Civil Engineering	
CEEN 6470	Performance-Based Engineering	
CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
BUAD 6000	Accounting and Finance for the Non-Financial Manager	
BUAD 6005	Economic Foundations for Marketing Decisions	
COSC 5610	Data Mining	
COSC 6050	Elements of Software Development	
COSC 6931	Topics in Computer Science	
ECON 6200	Economics for Management Decision Making	
EECE 5650	Introduction to Algorithms	
EECE 5830	Introduction to Computer Graphics	

EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
MBA 6100	Business Analytics	
MEEN 6101	Advanced Engineering Analysis 1	
MEEN 6102	Advanced Engineering Analysis 2	
MEEN 6470	Statistical Methods in Engineering	
MSSC 5700	Theory of Probability	
MSSC 5720	Statistical Methods	
MSSC 6020	Statistical Simulation	
MSSC 6931	Topics in Mathematical or Statistical Sciences	
Additional courses as approved by adviser and the CCEE director of graduate studies		
CEEN 6999	Master's Thesis	6
M.S. Thesis Defense and Submission of Approved Thesis		0
Total Credit Hours:		30

¹ Topics in CEEN 5931 Topics in Civil Engineering, CEEN 6932 Advanced Topics in Civil Engineering and CEEN 6995 Independent Study in Civil Engineering must pertain to the specialization of construction engineering.

For the Environmental and Water Resources Engineering (ENWR) specialization, Plan A students must complete:

Code	Title	Hours
Required specialization course work (12 credits minimum) chosen from the following:		12
CEEN 5230	Urban Hydrology and Stormwater Management	
CEEN 5515	Environmental Chemistry	
CEEN 5520	Industrial Wastewater Management	
CEEN 5525	Treatment Plant Design and Operation	
CEEN 5530	Hazardous and Industrial Waste Management	
CEEN 5535	Environmental Engineering Microbiology	
CEEN 5550	Water Resources Planning and Management	
CEEN 5715	Sustainable Engineering	
CEEN 5931	Topics in Civil Engineering (ENWR) ²	
CEEN 6340	Advanced Hydrology	
CEEN 6350	Introduction to Environmental Systems Modeling	
CEEN 6510	Biotechnology for Wastewater Management	
CEEN 6520	Environmental Laboratory 1 - Analyses	
CEEN 6521	Environmental Laboratory 2 - Processes	
CEEN 6540	Physical and Chemical Processes of Environmental Engineering	
CEEN 6560	Fate of Micropollutants	
CEEN 6932	Advanced Topics in Civil Engineering (ENWR) ²	
CEEN 6953	Graduate Seminar in Civil Engineering (ENWR) ²	
CEEN 6995	Independent Study in Civil Engineering (ENWR) ²	
Additional courses within the specialization as approved by adviser and the CCEE director of graduate studies		
Remaining courses chosen from the following or from the list above:		12
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5350	Law for Engineers	
CEEN 5931	Topics in Civil Engineering	
CEEN 6460	Engineering Reliability	
CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
BIOL 5102	Experimental Molecular Biology	
CHEM 5433	Physical Chemistry 1	
CHEM 5434	Physical Chemistry 2	

CHEM 5630	Introduction to Polymer Science	
CHEM 6201	Physical Methods of Analysis	
CHEM 6202	Spectrochemical Methods of Analysis	
CHEM 6203	Electroanalytical Methods	
CHEM 6204	Analytical Separations	
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
GEEN 6730	Project Management	
LAW 7730	Workshop: Environmental Practice	
Additional courses as approved by adviser and the CCEE director of graduate studies		
CEEN 6999	Master's Thesis	6
M.S. Thesis Defense and Submission of Approved Thesis		0
Total Credit Hours:		30

² Topics in CEEN 5931 Topics in Civil Engineering, CEEN 6932 Advanced Topics in Civil Engineering, CEEN 6953 Graduate Seminar in Civil Engineering and CEEN 6995 Independent Study in Civil Engineering must pertain to the specialization of environmental and water resources engineering.

For the Structural Engineering and Structural Mechanics (SESM) specialization, Plan A students must complete:

Code	Title	Hours
Required specialization course work (12 credits minimum) chosen from the following:		12
CEEN 5145 or MEEN 5230	Advanced Strength and Applied Stress Analysis Intermediate Mechanics of Materials	
CEEN 5411	Matrix Structural Analysis	
CEEN 5431	Advanced Structural Steel Design	
CEEN 5441	Advanced Reinforced Concrete Design	
CEEN 5450	Bridge Design	
CEEN 5850	FRP in Civil Engineering Infrastructure	
CEEN 5931	Topics in Civil Engineering (SESM) ³	
CEEN 6110	Theory of Elasticity	
CEEN 6120	Introduction to the Finite Element Method	
CEEN 6121	Applied Finite Element Analysis and Modeling	
CEEN 6410	Numerical Analysis with Structural Application	
CEEN 6420	Nonlinear Structural Analysis	
CEEN 6425	Earthquake Engineering	
CEEN 6435	Structural Dynamics	
CEEN 6470	Performance-Based Engineering	
CEEN 6932	Advanced Topics in Civil Engineering (SESM) ³	
CEEN 6995	Independent Study in Civil Engineering (SESM) ³	
MEEN 6230	Advanced Mechanics of Materials	
Additional courses within the specialization as approved by adviser and the CCEE director of graduate studies		
Remaining courses chosen from the following or from the list above:		12
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5350	Law for Engineers	
CEEN 5715	Sustainable Engineering	
CEEN 5830	Construction Planning, Scheduling, and Control	
CEEN 5840	Construction Cost Analysis and Estimating	
CEEN 5845	Construction Equipment and Methods	
CEEN 5931	Topics in Civil Engineering	
CEEN 6460	Engineering Reliability	
CEEN 6840	Infrastructure Information Modeling	

CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
GEEN 6730	Project Management	
MEEN 5240	Polymers and Polymer Composites	
MEEN 5245	Fatigue and Fracture Mechanics	
MEEN 5260	Introduction to Continuum Mechanics	
MEEN 5265	Intermediate Finite Element Methods	
MEEN 5420	Failure Analysis	
MEEN 5450	Mechanical Behavior of Materials	
MEEN 5485	Welding Engineering	
MEEN 5931	Topics in Mechanical Engineering	
MEEN 6101	Advanced Engineering Analysis 1	
MEEN 6102	Advanced Engineering Analysis 2	
MEEN 6103	Approximate Methods in Engineering Analysis	
MEEN 6470	Statistical Methods in Engineering	
MEEN 6931	Topics in Mechanical Engineering	
MSSC 5700	Theory of Probability	
Additional courses as approved by adviser and the CCEE director of graduate studies		
CEEN 6999	Master's Thesis	6
M.S. Thesis Defense and Submission of Approved Thesis		0
Total Credit Hours:		30

³ Topics in CEEN 5931 Topics in Civil Engineering, CEEN 6932 Advanced Topics in Civil Engineering and CEEN 6995 Independent Study in Civil Engineering must pertain to the specialization of structural engineering and structural mechanics.

For the Transportation Engineering and Materials (TEMA) specialization, Plan A students must complete:

Code	Title	Hours
Required specialization course work (12 credits minimum) chosen from the following:		12
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5615	Highway Planning and Design	
CEEN 5640	Traffic Characteristics and Design	
CEEN 5650	Pavement Design	
CEEN 5660	Pavement Management	
CEEN 5670	Advanced Transportation Materials	
CEEN 5931	Topics in Civil Engineering (TEMA) ⁴	
CEEN 6610	Advanced Traffic Operations Analysis and Design	
CEEN 6620	Urban Facility Design	
CEEN 6635	Highway Interchange Design	
CEEN 6650	Bituminous Materials	
CEEN 6655	Transportation Soils	
CEEN 6660	Advanced Pavement Design	
CEEN 6932	Advanced Topics in Civil Engineering (TEMA) ⁴	
CEEN 6995	Independent Study in Civil Engineering (TEMA) ⁴	
Additional courses within the specialization as approved by adviser and the CCEE director of graduate studies		
Remaining courses chosen from the following or from the list above:		12
CEEN 5230	Urban Hydrology and Stormwater Management	
CEEN 5310	Geographical Information Systems in Engineering and Planning	
CEEN 5350	Law for Engineers	
CEEN 5450	Bridge Design	

CEEN 5715	Sustainable Engineering	
CEEN 5830	Construction Planning, Scheduling, and Control	
CEEN 5840	Construction Cost Analysis and Estimating	
CEEN 5845	Construction Equipment and Methods	
CEEN 5850	FRP in Civil Engineering Infrastructure	
CEEN 5931	Topics in Civil Engineering	
CEEN 6460	Engineering Reliability	
CEEN 6470	Performance-Based Engineering	
CEEN 6840	Infrastructure Information Modeling	
CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
GEEN 6730	Project Management	
Additional courses as approved by adviser and the CCEE director of graduate studies		
CEEN 6999	Master's Thesis	6
M.S. Thesis Defense and Submission of Approved Thesis		0
Total Credit Hours:		30

⁴ Topics in CEEN 5931 Topics in Civil Engineering, CEEN 6932 Advanced Topics in Civil Engineering and CEEN 6995 Independent Study in Civil Engineering must pertain to the specialization of transportation engineering and materials.

PLAN B COURSE REQUIREMENTS

If no specialization is chosen, Plan B students must complete:

Code	Title	Hours
Required course work (30 credit hours) chosen from the following:		30
CEEN 5145	Advanced Strength and Applied Stress Analysis	
CEEN 5230	Urban Hydrology and Stormwater Management	
CEEN 5310	Geographical Information Systems in Engineering and Planning	
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5350	Law for Engineers	
CEEN 5411	Matrix Structural Analysis	
CEEN 5431	Advanced Structural Steel Design	
CEEN 5441	Advanced Reinforced Concrete Design	
CEEN 5450	Bridge Design	
CEEN 5515	Environmental Chemistry	
CEEN 5520	Industrial Wastewater Management	
CEEN 5525	Treatment Plant Design and Operation	
CEEN 5530	Hazardous and Industrial Waste Management	
CEEN 5535	Environmental Engineering Microbiology	
CEEN 5550	Water Resources Planning and Management	
CEEN 5615	Highway Planning and Design	
CEEN 5640	Traffic Characteristics and Design	
CEEN 5650	Pavement Design	
CEEN 5660	Pavement Management	
CEEN 5670	Advanced Transportation Materials	
CEEN 5715	Sustainable Engineering	
CEEN 5815	Mechanical and Electrical Systems for Buildings	
CEEN 5830	Construction Planning, Scheduling, and Control	
CEEN 5840	Construction Cost Analysis and Estimating	

CEEN 5845	Construction Equipment and Methods
CEEN 5850	FRP in Civil Engineering Infrastructure
CEEN 5931	Topics in Civil Engineering
CEEN 6110	Theory of Elasticity
CEEN 6120	Introduction to the Finite Element Method
CEEN 6121	Applied Finite Element Analysis and Modeling
CEEN 6340	Advanced Hydrology
CEEN 6350	Introduction to Environmental Systems Modeling
CEEN 6410	Numerical Analysis with Structural Application
CEEN 6420	Nonlinear Structural Analysis
CEEN 6425	Earthquake Engineering
CEEN 6435	Structural Dynamics
CEEN 6460	Engineering Reliability
CEEN 6470	Performance-Based Engineering
CEEN 6510	Biotechnology for Wastewater Management
CEEN 6520	Environmental Laboratory 1 - Analyses
CEEN 6521	Environmental Laboratory 2 - Processes
CEEN 6540	Physical and Chemical Processes of Environmental Engineering
CEEN 6560	Fate of Micropollutants
CEEN 6610	Advanced Traffic Operations Analysis and Design
CEEN 6620	Urban Facility Design
CEEN 6635	Highway Interchange Design
CEEN 6650	Bituminous Materials
CEEN 6655	Transportation Soils
CEEN 6660	Advanced Pavement Design
CEEN 6840	Infrastructure Information Modeling
CEEN 6932	Advanced Topics in Civil Engineering
CEEN 6953	Graduate Seminar in Civil Engineering
CEEN 6995	Independent Study in Civil Engineering
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)
GEEN 5830	Engineering Risk Analysis
GEEN 5840	Model-Based Systems Engineering
GEEN 6730	Project Management
Additional courses as approved by adviser and the CCEE director of graduate studies	
M.S. Oral Comprehensive Examination	0
Total Credit Hours:	30

For the Construction Engineering (CNEN) specialization, Plan B students must complete:

Code	Title	Hours
Required specialization course work (12 credits minimum) chosen from the following:		12
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5350	Law for Engineers	
CEEN 5660	Pavement Management	
CEEN 5815	Mechanical and Electrical Systems for Buildings	
CEEN 5830	Construction Planning, Scheduling, and Control	
CEEN 5840	Construction Cost Analysis and Estimating	
CEEN 5845	Construction Equipment and Methods	
CEEN 5931	Topics in Civil Engineering (CNEN) ¹	
CEEN 6460	Engineering Reliability	
CEEN 6840	Infrastructure Information Modeling	
CEEN 6932	Advanced Topics in Civil Engineering (CNEN) ¹	

CEEN 6995	Independent Study in Civil Engineering (CNEN) ¹	
GEEN 6730	Project Management	
Additional courses within the specialization as approved by adviser and the CCEE director of graduate studies		
Remaining courses chosen from the following or from the list above:		18
CEEN 5715	Sustainable Engineering	
CEEN 5931	Topics in Civil Engineering	
CEEN 6470	Performance-Based Engineering	
CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
BUAD 6000	Accounting and Finance for the Non-Financial Manager	
BUAD 6005	Economic Foundations for Marketing Decisions	
COSC 5610	Data Mining	
COSC 6050	Elements of Software Development	
COSC 6931	Topics in Computer Science	
ECON 6200	Economics for Management Decision Making	
EECE 5650	Introduction to Algorithms	
EECE 5830	Introduction to Computer Graphics	
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
MBA 6100	Business Analytics	
MEEN 6101	Advanced Engineering Analysis 1	
MEEN 6102	Advanced Engineering Analysis 2	
MEEN 6470	Statistical Methods in Engineering	
MSSC 5700	Theory of Probability	
MSSC 5720	Statistical Methods	
MSSC 6020	Statistical Simulation	
MSSC 6931	Topics in Mathematical or Statistical Sciences	
Additional courses as approved by adviser and the CCEE director of graduate studies		
M.S. Oral Comprehensive Examination		0
Total Credit Hours:		30

¹ Topics in CEEN 5931 Topics in Civil Engineering, CEEN 6932 Advanced Topics in Civil Engineering and CEEN 6995 Independent Study in Civil Engineering must pertain to the specialization of construction engineering.

For the Environmental and Water Resources Engineering (ENWR) specialization, Plan B students must complete:

Code	Title	Hours
Required specialization course work (12 credits minimum) chosen from the following:		12
CEEN 5230	Urban Hydrology and Stormwater Management	
CEEN 5515	Environmental Chemistry	
CEEN 5520	Industrial Wastewater Management	
CEEN 5525	Treatment Plant Design and Operation	
CEEN 5530	Hazardous and Industrial Waste Management	
CEEN 5535	Environmental Engineering Microbiology	
CEEN 5550	Water Resources Planning and Management	
CEEN 5715	Sustainable Engineering	
CEEN 5931	Topics in Civil Engineering (ENWR) ²	
CEEN 6340	Advanced Hydrology	
CEEN 6350	Introduction to Environmental Systems Modeling	
CEEN 6510	Biotechnology for Wastewater Management	
CEEN 6520	Environmental Laboratory 1 - Analyses	
CEEN 6521	Environmental Laboratory 2 - Processes	

CEEN 6540	Physical and Chemical Processes of Environmental Engineering	
CEEN 6560	Fate of Micropollutants	
CEEN 6932	Advanced Topics in Civil Engineering (ENWR) ²	
CEEN 6953	Graduate Seminar in Civil Engineering (ENWR) ²	
CEEN 6995	Independent Study in Civil Engineering (ENWR) ²	
Additional courses within the specialization as approved by adviser and the CCEE director of graduate studies		
Remaining courses chosen from the following or from the list above:		18
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5350	Law for Engineers	
CEEN 5931	Topics in Civil Engineering	
CEEN 6460	Engineering Reliability	
CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
BIOL 5102	Experimental Molecular Biology	
CHEM 5433	Physical Chemistry 1	
CHEM 5434	Physical Chemistry 2	
CHEM 5630	Introduction to Polymer Science	
CHEM 6201	Physical Methods of Analysis	
CHEM 6202	Spectrochemical Methods of Analysis	
CHEM 6203	Electroanalytical Methods	
CHEM 6204	Analytical Separations	
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
GEEN 6730	Project Management	
LAW 7730	Workshop: Environmental Practice	
Additional courses as approved by adviser and the CCEE director of graduate studies		
M.S. Oral Comprehensive Examination		0
Total Credit Hours:		30

² Topics in CEEN 5931 Topics in Civil Engineering, CEEN 6932 Advanced Topics in Civil Engineering, CEEN 6953 Graduate Seminar in Civil Engineering and CEEN 6995 Independent Study in Civil Engineering must pertain to the specialization of environmental and water resources engineering.

For the Structural Engineering and Structural Mechanics (SESM) specialization, Plan B students must complete:

Code	Title	Hours
Required specialization course work (12 credits minimum) chosen from the following:		12
CEEN 5145 or MEEN 5230	Advanced Strength and Applied Stress Analysis Intermediate Mechanics of Materials	
CEEN 5411	Matrix Structural Analysis	
CEEN 5431	Advanced Structural Steel Design	
CEEN 5441	Advanced Reinforced Concrete Design	
CEEN 5450	Bridge Design	
CEEN 5850	FRP in Civil Engineering Infrastructure	
CEEN 5931	Topics in Civil Engineering (SESM) ³	
CEEN 6110	Theory of Elasticity	
CEEN 6120	Introduction to the Finite Element Method	
CEEN 6121	Applied Finite Element Analysis and Modeling	
CEEN 6410	Numerical Analysis with Structural Application	
CEEN 6420	Nonlinear Structural Analysis	
CEEN 6425	Earthquake Engineering	
CEEN 6435	Structural Dynamics	

CEEN 6470	Performance-Based Engineering	
CEEN 6932	Advanced Topics in Civil Engineering (SESM) ³	
CEEN 6995	Independent Study in Civil Engineering (SESM) ³	
MEEN 6230	Advanced Mechanics of Materials	
Additional courses within the specialization as approved by adviser and the CCEE director of graduate studies		
Remaining courses chosen from the following or from the list above:		18
CEEN 5340	Urban Planning for Civil Engineers	
CEEN 5350	Law for Engineers	
CEEN 5715	Sustainable Engineering	
CEEN 5830	Construction Planning, Scheduling, and Control	
CEEN 5840	Construction Cost Analysis and Estimating	
CEEN 5845	Construction Equipment and Methods	
CEEN 5931	Topics in Civil Engineering	
CEEN 6460	Engineering Reliability	
CEEN 6840	Infrastructure Information Modeling	
CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
GEEN 6730	Project Management	
MEEN 5240	Polymers and Polymer Composites	
MEEN 5245	Fatigue and Fracture Mechanics	
MEEN 5260	Introduction to Continuum Mechanics	
MEEN 5265	Intermediate Finite Element Methods	
MEEN 5420	Failure Analysis	
MEEN 5450	Mechanical Behavior of Materials	
MEEN 5485	Welding Engineering	
MEEN 5931	Topics in Mechanical Engineering	
MEEN 6101	Advanced Engineering Analysis 1	
MEEN 6102	Advanced Engineering Analysis 2	
MEEN 6103	Approximate Methods in Engineering Analysis	
MEEN 6470	Statistical Methods in Engineering	
MEEN 6931	Topics in Mechanical Engineering	
MSSC 5700	Theory of Probability	
Additional courses as approved by adviser and the CCEE director of graduate studies		
M.S. Oral Comprehensive Examination		0
Total Credit Hours:		30

³ Topics in CEEN 5931 Topics in Civil Engineering, CEEN 6932 Advanced Topics in Civil Engineering and CEEN 6995 Independent Study in Civil Engineering must pertain to the specialization of structural engineering and structural mechanics.

For the Transportation Engineering and Materials (TEMA) specialization, Plan B students must complete:

Code	Title	Hours
Required specialization course work (12 credits minimum) chosen from the following:		
CEEN 5340	Urban Planning for Civil Engineers	12
CEEN 5615	Highway Planning and Design	
CEEN 5640	Traffic Characteristics and Design	
CEEN 5650	Pavement Design	
CEEN 5660	Pavement Management	
CEEN 5670	Advanced Transportation Materials	
CEEN 5931	Topics in Civil Engineering (TEMA) ⁴	

CEEN 6610	Advanced Traffic Operations Analysis and Design	
CEEN 6620	Urban Facility Design	
CEEN 6635	Highway Interchange Design	
CEEN 6650	Bituminous Materials	
CEEN 6655	Transportation Soils	
CEEN 6660	Advanced Pavement Design	
CEEN 6932	Advanced Topics in Civil Engineering (TEMA) ⁴	
CEEN 6995	Independent Study in Civil Engineering (TEMA) ⁴	
Additional courses within the specialization as approved by adviser and the CCEE director of graduate studies		
Remaining courses chosen from the following or from the list above:		18
CEEN 5230	Urban Hydrology and Stormwater Management	
CEEN 5310	Geographical Information Systems in Engineering and Planning	
CEEN 5350	Law for Engineers	
CEEN 5450	Bridge Design	
CEEN 5715	Sustainable Engineering	
CEEN 5830	Construction Planning, Scheduling, and Control	
CEEN 5840	Construction Cost Analysis and Estimating	
CEEN 5845	Construction Equipment and Methods	
CEEN 5850	FRP in Civil Engineering Infrastructure	
CEEN 5931	Topics in Civil Engineering	
CEEN 6460	Engineering Reliability	
CEEN 6470	Performance-Based Engineering	
CEEN 6840	Infrastructure Information Modeling	
CEEN 6932	Advanced Topics in Civil Engineering	
CEEN 6995	Independent Study in Civil Engineering	
EECE 6931	Topics in Electrical and Computer Engineering (Topic: Renewable Energy: Policy, Technology and Integration)	
GEEN 5830	Engineering Risk Analysis	
GEEN 5840	Model-Based Systems Engineering	
GEEN 6730	Project Management	
Additional courses as approved by adviser and the CCEE director of graduate studies		
M.S. Oral Comprehensive Examination		0
Total Credit Hours:		30

⁴ Topics in CEEN 5931 Topics in Civil Engineering, CEEN 6932 Advanced Topics in Civil Engineering and CEEN 6995 Independent Study in Civil Engineering must pertain to the specialization of transportation engineering and materials.

Accelerated Bachelor's-Master's Degree Program

The department offers a five-year combined B.S./M.S. program known as the Accelerated Degree Program (ADP). This program enables students to earn both a bachelor of science degree in either civil engineering or construction engineering and a master of science degree in civil engineering in just five years (or six with completion of a co-op). Students currently enrolled in an undergraduate degree program in the Department of Civil, Construction and Environmental Engineering at Marquette University (with a GPA of 3.500 or above) may apply for admission to the ADP during their junior year. Students must submit an application to the Marquette University Graduate School, indicate their interest in the ADP, and meet all other admission criteria as stated in the Application Requirements section of the Graduate Bulletin.

In addition to completing their undergraduate degree requirements, students take master's level courses during their senior year. A total of 12 graduate credits (i.e., courses numbered 5000 or above) may be taken while the student is an undergraduate for consideration toward graduate degree requirements. A maximum of 6 of these credits may be applied to both the undergraduate and graduate degree requirements. The remaining master's level course work is taken during the student's fifth year. Students are strongly encouraged to pursue Plan A (thesis option), in which work on the thesis research should begin during the summer between the junior and senior years. Students continue to gain research experience during the summer between the senior and fifth years, continuing throughout the fifth year and culminating in preparation of a written thesis and defense. Accelerated degree programs following Plan B (course work option) may also be designed.

Application of Master's Across Boundaries (MAB) Graduate Certificates toward the M.S. Degree in Civil Engineering (Plan B only)

The Department of Civil, Construction and Environmental Engineering (CCEE) may approve a maximum of 24 credit hours of course work from up to two (2) previously earned MAB graduate certificates to be applied toward the requirements of the M.S. degree (Plan B only), provided that the relevant certificate course work meets all conditions of the Marquette University Graduate School's transfer-credit policy. All program criteria for the M.S. degree must still be met once the certificate is integrated into the student's course work plan. The application of specific certificate course work toward the various M.S. (Plan B) specializations are determined at the time the student is admitted to the M.S. program. Students are encouraged to meet with their M.S. academic adviser in planning their remaining M.S. course work.

University Policies

- Academic Censure - Graduate School (<https://bulletin.marquette.edu/policies/academic-censure/graduate/>)
- Academic Integrity (<https://bulletin.marquette.edu/policies/academic-integrity/>)
- Academic Misconduct (<https://bulletin.marquette.edu/policies/academic-misconduct-policy/>)
- Academic Program Definitions (<https://bulletin.marquette.edu/policies/academic-programs-defined/>)
- Accelerated Degree Programs (<https://bulletin.marquette.edu/policies/accelerated-degree-programs/>)
- Attendance - Graduate School (<https://bulletin.marquette.edu/policies/attendance/graduate/>)
- Awarding Diplomas and Certificates (<https://bulletin.marquette.edu/policies/awarding-diplomas-certificates/>)
- Background Checks, Drug Testing (<https://bulletin.marquette.edu/policies/background-checks-drug-testing/>)
- Class Rank (<https://bulletin.marquette.edu/policies/class-rank/>)
- Commencement (<https://bulletin.marquette.edu/policies/commencement/>)
- Conferral of Degrees and Certificates (<https://bulletin.marquette.edu/policies/conferral-degrees-certificates/>)
- Course Levels (<https://bulletin.marquette.edu/policies/course-levels/>)
- Credit Hour (<https://bulletin.marquette.edu/policies/credit/>)
- Credit Load - Graduate School (<https://bulletin.marquette.edu/policies/credit-load/graduate/>)
- Faculty Grading (<https://bulletin.marquette.edu/policies/faculty-grading/>)
- Family Education Rights and Privacy Act-FERPA (<https://bulletin.marquette.edu/policies/ferpa/>)
- Grade Appeals (<https://bulletin.marquette.edu/policies/grade-appeals/>)
- Grading System - Graduate School and Graduate School of Management (<https://bulletin.marquette.edu/policies/grading-system/graduate-management/>)
- Graduation - Graduate School (<https://bulletin.marquette.edu/policies/graduation/graduate/>)
- Immunization and Tuberculosis Screening Requirements (<https://bulletin.marquette.edu/policies/immunization-and-tuberculosis-screening/>)
- Last Date of Attendance/Activity (<https://bulletin.marquette.edu/policies/last-dateof-attendance-activity/>)
- Military Call to Active Duty or Training (<https://bulletin.marquette.edu/policies/militarycall-active-duty-training/>)
- Registration - Graduate School (<https://bulletin.marquette.edu/policies/registration/graduate/>)
- Repeated Courses - Graduate School (<https://bulletin.marquette.edu/policies/repeated-courses/graduate/>)
- Student Data Use and Privacy (<https://bulletin.marquette.edu/policies/student-data-use-privacy/>)
- Transcripts-Official (<https://bulletin.marquette.edu/policies/transcripts-official/>)
- Transfer Course Credit - Graduate School (<https://bulletin.marquette.edu/policies/transfer-course-credit-policy/graduate/>)
- Withdrawal - Graduate School (<https://bulletin.marquette.edu/policies/withdrawals/graduate/>)

Graduate School Policies

- Academic Performance (<https://bulletin.marquette.edu/graduate/policies/academic-performance/>)
- Academic Programs Overview (<https://bulletin.marquette.edu/graduate/policies/academic-programs-overview/>)
- Advising (<https://bulletin.marquette.edu/graduate/policies/advising/>)
- Assistantships and Fellowships (<https://bulletin.marquette.edu/graduate/policies/assistantships-andfellowships/>)
- Certificate Concurrent Enrollment (<https://bulletin.marquette.edu/graduate/policies/certificate-concurrent-enrollment/>)
- Conduct (<https://bulletin.marquette.edu/graduate/policies/conduct/>)
- Confidentiality of Proprietary Information (<https://bulletin.marquette.edu/graduate/policies/confidentiality-proprietary-information/>)
- Continuous Enrollment (<https://bulletin.marquette.edu/graduate/policies/continuous-enrollment/>)
- Courses and Prerequisites (<https://bulletin.marquette.edu/graduate/policies/courses-prerequisites/>)
- Cross-listed Courses (<https://bulletin.marquette.edu/graduate/policies/cross-listed-courses/>)
- Deadlines (<https://bulletin.marquette.edu/graduate/policies/deadlines/>)

- Graduate Credit (<https://bulletin.marquette.edu/graduate/policies/graduate-credit/>)
- Graduate School Policies (<https://bulletin.marquette.edu/graduate/policies/>)
- Independent Study (<https://bulletin.marquette.edu/graduate/policies/independent-study/>)
- Intellectual Property (<https://bulletin.marquette.edu/graduate/policies/intellectual-property/>)
- Research Involving Humans, Animals, Radioisotopes or Recombinant DNA/Transgenic Organisms (<https://bulletin.marquette.edu/graduate/policies/research-involving-humans-animals-radioisotopes-recombinant-dnatransgenic-organisms/>)
- Temporary Withdrawal from Graduate Program (<https://bulletin.marquette.edu/graduate/policies/temporary-withdrawal-graduate-program/>)
- Time Limitations (<https://bulletin.marquette.edu/graduate/policies/time-limitations/>)
- Working with Minors (<https://bulletin.marquette.edu/graduate/policies/working-minors/>)

Civil Engineering Graduate Programs

- Civil Engineering, MS (p. 1)
- Civil Engineering, PHD (<https://bulletin.marquette.edu/graduate/civil-engineering-phd/>)

CEEN 5145 Advanced Strength and Applied Stress Analysis (3 credits)

Basic concepts of mechanics of deformable bodies. Two- and three-dimensional stress-strain relationships and theories of failure. Unsymmetrical bending analyses. Shear flow and shear center. Torsion of thin-walled sections (tubular and non-tubular). Composite beams. Stress concentration. Energy principles: strain and complementary energy. Castigliano's theorem.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2011 Fall Term, 2009 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205145>)

CEEN 5230 Urban Hydrology and Stormwater Management (3 credits)

Distribution and properties of water on the earth. Concept of the hydrologic cycle and basic principles governing water movement in the environment: precipitation, evapotranspiration, infiltration, runoff generation, streamflow and groundwater flow. Engineering methods of design of flood protection, stormwater management and stormwater pollution abatement systems.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205230>)

CEEN 5310 Geographical Information Systems in Engineering and Planning (3 credits)

Fundamentals of GIS, databases, data management, map projections, representations of spatial attributes, GIS analysis and GIS software systems such as ARC Info, ARC View, Grass. GIS use and expanded capabilities are taught. Case studies including environmental, transportation and economic applications are discussed.

Level of Study: Graduate

Last four terms offered: 2013 Spring Term, 2012 Spring Term, 2011 Spring Term, 2010 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205310>)

CEEN 5340 Urban Planning for Civil Engineers (3 credits)

Concepts and principles underlying urban planning and development. Land use, transportation, utility, community facility planning problems, procedures, and techniques. The master plan and implementation devices such as zoning, subdivision control, official mapping, capital budgeting, and urban renewal.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2020 Fall Term, 2019 Fall Term, 2018 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205340>)

CEEN 5350 Law for Engineers (3 credits)

Basic legal principles and awareness of typical legal questions that arise when engineers and law interact. Topics include: American judicial system, law of contracts, forms of association, construction contracts, professional liabilities of engineers and torts.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205350>)

CEEN 5411 Matrix Structural Analysis (3 credits)

Introduction to symbolic and numerical linear algebra computations using commercial software. Modeling axial, bending, and torsion deformations in structural members using polynomials. Application of the principle of virtual work to compute deflections for statically determinate and indeterminate problems. Formulation of the matrix stiffness method via the principle of virtual displacements and the matrix flexibility method via the principle of virtual forces. Application of the matrix stiffness method for solving statically indeterminate structural analysis problems. Use of approximate methods of structural analysis (cantilever and portal methods) for critical evaluation of software-generated solutions. Use of commercial software for structural analysis.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2020 Fall Term, 2019 Fall Term, 2018 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205411>)

CEEN 5431 Advanced Structural Steel Design (3 credits)

Continuation of CEEN 3430. Design of plate girders, composite beam and slab systems, composite columns and composite beam-columns, simple connections, moment connections, hollow structural shape (HSS) connections, bracing systems and single and multi-story steel framed building systems. Emphasis on AISC Specifications

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2021 Spring Term, 2020 Spring Term, 2019 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205431>)

CEEN 5441 Advanced Reinforced Concrete Design (3 credits)

Presents advanced concrete design applications to reinforced concrete statically indeterminate systems, two-way slabs, short and slender columns, footings, and walls. Emphasis on ACI code requirements.

Prerequisite: Prior course work in reinforced concrete design.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205441>)

CEEN 5443 Prestressed Concrete Design (3 credits)

Introduction to basic principles and procedures for the design and analysis of prestressed concrete members, including calculations of prestress loss, flexural analysis and design, shear, bond and anchorage requirements, member deflections and cable layouts. Emphasis on ACI and PCI code requirements.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205443>)

CEEN 5450 Bridge Design (3 credits)

Introduction to bridge engineering and construction including: an abbreviated history of bridge construction; bridge types; bridge nomenclature; lessons from failures; design philosophies; and the construction process. Analysis of single- and multi-span bridge superstructures using classical techniques and commercial software. Design of single-span reinforced concrete slab bridges; reinforced concrete bridge decks; and single-span slab-bridges in prestressed concrete.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205450>)

CEEN 5505 Air Quality Engineering (3 credits)

Applies engineering principles to identify, quantify and mitigate sources of air pollution. Takes a systems approach to quantify sources of air pollution, model fate and transport in the environment, identify public health and welfare aspects, develop monitoring and measuring programs, interpret regulatory framework, and design engineering solutions. Atmospheric physics and chemistry are applied in air dispersion modeling to predict air quality impacts. Air pollution control technologies are evaluated to design practical and economic solutions.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205505>)

CEEN 5515 Environmental Chemistry (3 credits)

Chemical stoichiometry, equilibrium, and kinetics relating to natural and engineered environmental systems. Basic concepts from organic and inorganic chemistry including oxidation-reduction reactions, acid-base chemistry, the carbonate system, alkalinity and acidity. Equilibrium and kinetic theories of chemical partitioning among gas, liquid and solid phases governing chemical fate and transport in the environment. Coordination chemistry describing metal-ligand interactions, precipitation and bioavailability of materials.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2021 Summer Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205515>)

CEEN 5520 Industrial Wastewater Management (3 credits)

Review of federal legislation and state regulations with regard to industrial wastewater management practices. Consideration of industrial process modifications and wastewater treatment options with respect to their effect on industrial user fees. Pretreatment standards and discharge permit requirements. Case studies of specific industrial applications.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2021 Spring Term, 2019 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205520>)

CEEN 5525 Treatment Plant Design and Operation (3 credits)

Review of water and wastewater characteristics, drinking water, receiving water and effluent standards. Basic design methodology and operational features of common physical, chemical and biological processes for the treatment of waters and wastewaters. Introduction to the processing and disposal of sludges and other treatment plant residuals.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205525>)

CEEN 5530 Hazardous and Industrial Waste Management (3 credits)

Overview of hazardous waste management, disposal and soil and ground water remediation. Review of RCRA, CERCLA-SARA, TSCA and Wisconsin's NR 700 and other regulations. Definition of hazardous wastes and characterization of industrial waste stream. Chemical, physical and biological properties of hazardous wastes. Introduction to hazardous waste remediation/treatment methods and technologies. Landfills and the RCRA Land Ban regulations. Site assessments, field investigations and laboratory analytical techniques. Environmental risk assessments, cleanup objectives and waste minimization.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2020 Spring Term, 2018 Spring Term, 2016 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205530>)

CEEN 5535 Environmental Engineering Microbiology (3 credits)

Includes microbiological and biochemical properties of microorganisms important in environmental engineering practice. General fundamentals of environmental microbiology and their application to drinking water treatment and distribution, water pollution control and natural systems.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205535>)

CEEN 5550 Water Resources Planning and Management (3 credits)

Planning and management of water resources. Institutional frameworks for water resources engineering. Comprehensive integration of the engineering economic, social and legal aspects of water resources planning and management. Case studies of water use and environmental resources are studied.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2019 Fall Term, 2018 Fall Term, 2017 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205550>)

CEEN 5595 GIS Applications in Water Resources (3 credits)

Use of Geographical Information Systems (GIS) concepts and methods to solve water resources problems. GIS fundamentals such as databases, map projections, spatial analysis and raster analysis. Applications for water resources engineering including terrain analysis, watershed characterization and hydrologic analysis and modeling. Approaches to GIS integration with modeling software and online tools.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205595>)

CEEN 5615 Highway Planning and Design (3 credits)

Emphasis on highway planning, alternate highway alignments and alternate evaluation. Geometric design of highways including horizontal and vertical alignment, cross-section design. Projects on detailed design of reverse curves (plan and profile views); intersection design; cross-section and earthwork quantities. Legal aspects of engineering. Use of American Association of State Highway and Transportation Officials design guidelines.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2021 Spring Term, 2019 Spring Term, 2018 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205615>)

CEEN 5640 Traffic Characteristics and Design (3 credits)

Components of the traffic system: vehicle and road user characteristics, geometric design and traffic controls. Intersection types, cross-section design elements and typical dimensions. Basic variables of traffic flow, observed traffic flow values. Freeway operations. Signalized intersections: flow, capacity, level of service. Projects addressing: intersection existing conditions (traffic, geometry, signalization); approach delay; safety performance; capacity; suggestions for improvements. Use of the Highway Capacity Manual and the Highway Capacity Software. Emphasis on technical report-writing and presentation.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205640>)

CEEN 5650 Pavement Design (3 credits)

Study of the behavior and properties of highway pavements with emphasis on hot mix asphalt and jointed Portland cement concrete pavement. Pavement thickness designs are developed using current design methods and incorporating subgrade soil properties, traffic forecasts and pavement performance expectations. Use of spreadsheets and computer programs are required.

Prerequisite: CEEN 3160 and CEEN 3610; or equiv.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2016 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205650>)

CEEN 5660 Pavement Management (3 credits)

Study of the performance of pavement systems based on design, traffic and maintenance activities. Methods for evaluating in-service pavements including distress surveys and nondestructive testing are examined. Maintenance strategies are developed and life-cycle cost analysis of these strategies are studied.

Prerequisite: CEEN 3610 or equiv.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205660>)

CEEN 5670 Advanced Transportation Materials (3 credits)

Advanced study of materials used for constructing transportation facilities, with particular emphasis on subgrade soils, bound and unbound aggregates, hot mix asphalt and Portland cement concrete. Laboratory test are conducted and analytical models used for characterizing transportation materials are examined.

Level of Study: Graduate

Last four terms offered: 2016 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205670>)

CEEN 5715 Sustainable Engineering (3 credits)

Provides a framework for the theory and practice of sustainable engineering. Introduces the importance and role of technological, social and sustainable systems in the modern world, which is increasingly characterized by integrated human/natural/built complex adaptive systems at local, regional and global scales. Develops critical problem solving approaches, including life-cycle assessment, global awareness, consciousness of patterns in technological evolution, and strategies for addressing environmental, economic and social equity issues in engineering design.

Level of Study: Graduate

Last four terms offered: 2020 Spring Term, 2019 Spring Term, 2017 Spring Term, 2016 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205715>)

CEEN 5815 Mechanical and Electrical Systems for Buildings (3 credits)

Provides basic knowledge of electrical, plumbing and HVAC systems used in residential, commercial and industrial buildings. Studies the advantages and disadvantages of various systems, and how their design and installation integrates into the management of the building process. Particular attention is given to soliciting and managing mechanical and electrical subcontractors.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205815>)

CEEN 5830 Construction Planning, Scheduling, and Control (3 credits)

A study of principles and techniques used to plan, schedule and control costs on building construction projects. Network and linear scheduling models, resource allocation and time-cost analysis. Develops an appreciation of the resources required in a project and their limitations and introduces the techniques for analyzing and improving their use. Develops an understanding of the correlation between project planning and control and cost estimating and scheduling.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205830>)

CEEN 5840 Construction Cost Analysis and Estimating (3 credits)

Study of various cost estimating methods and their applications. Topics include: labor, material, equipment and indirect costs; quantity takeoff; analysis of historical cost data; forecasting and computerized estimating methods.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205840>)

CEEN 5845 Construction Equipment and Methods (3 credits)

Construction equipment and productivity analysis. Design of equipment fleet operations. Design of temporary structures used during construction such as earth retaining structures and concrete formwork systems. Construction equipment safety and safety standards related to earthwork and concrete forming operations.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Fall Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205845>)

CEEN 5850 FRP in Civil Engineering Infrastructure (3 credits)

Introduces Fiber Reinforced Polymer (FRP) material properties, FRP reinforced concrete, FRP prestressed concrete, FRP repaired and retrofitted structures and pure FRP structures.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205850>)

CEEN 5931 Topics in Civil Engineering (1-3 credits)

Course content announced each term. Potential topics include: probability concepts in engineering, advanced roadway facility design, engineering economy, highway bridge analysis and design, structural engineering of sports facilities.

Prerequisite: Cons. of instr.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2021 Spring Term, 2020 Spring Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%205931>)

CEEN 6110 Theory of Elasticity (3 credits)

Mathematical preliminaries (indicial notation, vectors, Cartesian tensors, coordinate transformations, eigenvalue problems, divergence theorem); kinematic relations (strain-displacement and compatibility); stress tensor and traction vector; differential and virtual work expressions of equilibrium; constitutive relations; stored energy functions; formulation of elastostatics boundary value problems; uniqueness theorems; theorem of minimum potential energy; Saint-Venant's principle; Saint-Venant beam theory; plane stress and plane strain.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2019 Fall Term, 2017 Fall Term, 2015 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206110>)

CEEN 6120 Introduction to the Finite Element Method (3 credits)

Theoretical development of the finite element method (FEM) of analysis, with particular emphasis on problems of solid mechanics; development of element stiffness matrices for axial, beam, plane stress, plane strain, plate, shell, and solid elements; synthesis of global stiffness matrix, solution of the finite element equations; introduction to numerical implementation of FEM and general purpose FEM software.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2020 Fall Term, 2018 Fall Term, 2016 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206120>)

CEEN 6121 Applied Finite Element Analysis and Modeling (3 credits)

Review of linear elastic finite element analysis (FEA) theory in solid/structural mechanics; review of commercial FEA code use (ANSYS®) in linear elastic applications; introduction to advanced theories, including theories of vibration, material nonlinearities, geometric nonlinearities, structural instabilities, and/or time-dependent deformations (creep); use of ANSYS® to simulate complex structural behavior; model development, verification, and improvement.

Prerequisite: CEEN 6120 or equiv.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2019 Spring Term, 2017 Spring Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206121>)

CEEN 6210 River Engineering (3 credits)

Offers a solid background in the basic principles of open-channel hydraulics, gradually-varied flow, rapidly-varied flow, hydrologic and hydraulic flood routing, and river restoration/naturalization. Hand calculations of numerous open-channel flow problems, and application of the HEC-RAS program for backwater analysis and for flood routing in combination with HEC-1. Includes concepts for stream restoration/naturalization.

Level of Study: Graduate

Last four terms offered: 2013 Spring Term, 2011 Spring Term, 2009 Spring Term, 2007 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206210>)

CEEN 6340 Advanced Hydrology (3 credits)

Measurement of hydrologic phenomena including precipitation and streamflow. Applications of statistics to hydrology, floods and droughts. Hydrologic design of water resources development and management projects. State-of-the-art computer models for watershed management and urban hydrology.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2020 Spring Term, 2019 Spring Term, 2018 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206340>)

CEEN 6350 Introduction to Environmental Systems Modeling (3 credits)

Introduction to hydraulic and hydrologic models with applications to water resources engineering. Continuity equations. Analytical and numerical methods for linear, nonlinear and coupled systems. Model applications include calibration and validation, parameter estimation and optimization methods. Model systems include surface and subsurface waters, storm water and combined sewer collection systems and water distribution systems.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2019 Fall Term, 2017 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206350>)

CEEN 6410 Numerical Analysis with Structural Application (3 credits)

Interpolation polynomials; numerical integration and differentiation; Taylor series, Fourier, cubic spline, and least-squares polynomial approximations; numerical solution of initial-value problems by Prediction-Correction and Runge-Kutta methods; numerical solution of boundary-value problems by finite difference method; numerical solution of integral equations; approximate solution of ordinary differential equations by weighted residuals and Galerkin methods; approximate solution of variational problems by Rayleigh-Ritz method.

Level of Study: Graduate

Last four terms offered: 2020 Spring Term, 2018 Spring Term, 2014 Spring Term, 2012 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206410>)

CEEN 6420 Nonlinear Structural Analysis (3 credits)

Application of the principle of virtual displacements in the formulation of element stiffness equations that include geometric and material nonlinearity. Determination of critical (buckling) loads of structural systems using eigenvalue analysis. Formulation and application of algorithms for nonlinear structural analysis. Application of commercial software in geometrically nonlinear analysis, materially nonlinear analysis, and critical load (buckling) analysis.

Prerequisite: CEEN 5411.

Level of Study: Graduate

Last four terms offered: 2012 Spring Term, 2010 Spring Term, 2008 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206420>)

CEEN 6425 Earthquake Engineering (3 credits)

Introduction to the mechanics of ground motion (earthquake) and its effects on building and bridge structures. Application of structural dynamics principles in relation to structural analysis for earthquake-generated forces. Response to simulation of single degree of freedom and multi-degree of freedom linear structural systems to earthquake-induced ground accelerations using Newmark response history analysis (RHA), modal response history analysis (mRHA) and response spectrum analysis (RSA). Discussion of philosophies upon which building-code IBC, NEHRP) mandated earthquake analysis and design procedures are based.

Prerequisite: CEEN 3430, CEEN 3440, CEEN 5411, CEEN 6435.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2016 Spring Term, 2013 Spring Term, 2011 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206425>)

CEEN 6435 Structural Dynamics (3 credits)

Formulation of single-degree-of-freedom (SDOF) equation of motion; generalized SDOF systems; free-vibration response; harmonic excitation; periodic loading and Fourier series; impulsive loads; response (shock) spectra; general response by Duhamel and Fourier integrals; non-linear dynamic analysis; Rayleigh's method; formulation of multiple-degree-of-freedom (MDOF) equations of motion; structural property matrices and load vectors; eigenvalue problem for natural frequencies and mode shapes; orthogonality of mode shapes; mode superposition.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2020 Fall Term, 2016 Fall Term, 2014 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206435>)

CEEN 6445 Advanced Materials for Civil Infrastructures (3 credits)

Introduction to advanced materials developed in recent decades for civil infrastructures, such as high-performance concrete, self-healing concrete, high strength steel, composites, recycled materials, green materials, nanomaterials, etc. Emphasis on fundamentals of material science, mechanics and application of these materials.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206445>)

CEEN 6460 Engineering Reliability (3 credits)

Introduces concepts and applications of engineering reliability. Presents how to formulate a reliability question to solve engineering problems of interest; compute first- and second-order estimates of failure probabilities of engineered systems; compute sensitivities of failure probabilities to assumed parameter values; measure the relative importance of the random variables associated with a system; identify the relative advantages and disadvantages of various analytical reliability methods as well as Monte Carlo simulation; update reliability estimates based on new observational data; and compute system reliability for series and parallel systems. Knowledge of basic Matlab programming helpful.

Prerequisite: Requires basic knowledge of probability and statistics, descriptions of random variables, probability distributions, functions of random variables, estimation of model parameters, model selection and verification, covered by MSCS 6010 or equivalent; EECE 6020, CEEN 4320/5320, MATH 4700/5700, 4710/5710, 4720/5720; linear algebra, systems of equations, matrix operations, transformations; calculus and differential equations, differentiation, integration, ordinary and partial differential equations.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2018 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206460>)

CEEN 6470 Performance-Based Engineering (3 credits)

Provides an opportunity to utilize and master the framework of performance-based engineering to aid decision making via useful applications. Presents how to estimate the hazard at the site and system of interest, in order to assess system response, predict damage extent, and evaluate system performance in terms of expected loss. Topics include: analyses of hazard, response, damage and loss; synthesis of recent advancement in research and practice with case studies; emphasis on the impact of earthquakes on buildings, with extension to other hazards and systems. Knowledge of basic Matlab programming helpful.

Prerequisite: Requires basic knowledge of probability and statistics, equivalent to MATH 4700/5700, 4710/5710, 4720/5720, or CEEN 4320.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2017 Fall Term, 2016 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206470>)

CEEN 6510 Biotechnology for Wastewater Management (3 credits)

Study of biologically catalyzed chemical transformations in engineered systems. Presentation of microbiology, biologically important oxidation-reduction reactions, bioenergetic principles, kinetics and toxicity considerations relating to wastewater treatment and nutrient management. Aerobic processes for biochemical oxygen demand reduction and ammonia oxidation, anoxic processes for denitrification as well as processes for anammox and nitrification/denitrification reactions. Anaerobic processes for biomethane and renewable energy production.

Prerequisite: CEEN 5525 or equiv.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2019 Fall Term, 2017 Fall Term, 2015 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206510>)

CEEN 6520 Environmental Laboratory 1 - Analyses (3 credits)

Physical, chemical and biological analyses for the characterization of waters, wastewaters, solid wastes, sludges and leachates. Use of modern instrumentation in laboratory analysis. Applicability of analytical results to the environmental field.

Prerequisite: CEEN 3510 and CEEN 5515.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2018 Fall Term, 2016 Fall Term, 2014 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206520>)

CEEN 6521 Environmental Laboratory 2 - Processes (3 credits)

Theoretical principles and laboratory experimentation governing the processes of settling, coagulation, adsorption, flotation, disinfection, oxygen transfer, biological treatment and sludge conditioning, thickening and dewatering.

Prerequisite: CEEN 5525 and CEEN 6520.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2019 Fall Term, 2017 Fall Term, 2015 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206521>)

CEEN 6540 Physical and Chemical Processes of Environmental Engineering (3 credits)

Theory and design of unit operations and processes utilized for the treatment of water and wastewater, including coagulation, flocculation, sedimentation, filtration, adsorption, ion exchange and aeration.

Prerequisite: CEEN 5515 and CEEN 5525.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2021 Spring Term, 2019 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206540>)

CEEN 6560 Fate of Micropollutants (3 credits)

Presents how to predict what a compound will do in an environment, based on the structure of the molecule. Discusses publications in peer-reviewed literature. Develops skills including critical thinking, public speaking via oral presentations, and technical writing.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2018 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206560>)

CEEN 6610 Advanced Traffic Operations Analysis and Design (3 credits)

Traffic stream characteristics-volume, flow rate, speed, density. Facility characteristics-level of service, capacity. Uninterrupted flow facility operations analysis: basic freeway segments, freeway weaving areas, merge and diverge areas, two-lane highways. Interrupted flow facility operations analysis: two-way and all-way stop controlled intersections; roundabouts. Non-highway facility operations analysis: pedestrian paths, bicycle paths and transit routes. Safety performance of highway facilities. Use of the Highway Capacity Manual and the Highway Capacity Software. Existing facility conditions, design upgrades.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2020 Fall Term, 2010 Fall Term, 2008 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206610>)

CEEN 6620 Urban Facility Design (3 credits)

Design controls overview. Access management location, spacing and design. Intersection design elements and traffic control devices. Local street design; Collector street design; Arterial street design. Roadside design-roadside obstacles. Bus and rail transit design for on- and off-street operation.

Level of Study: Graduate

Last four terms offered: 2009 Fall Term, 2005 Fall Term, 2003 Fall Term, 2001 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206620>)

CEEN 6635 Highway Interchange Design (3 credits)

Planning, analysis, design and operational analysis of highway interchanges. Determination and adaptability of interchange types for freeway-to-freeway and service interchanges.

Level of Study: Graduate

Last four terms offered: 2005 Spring Term, 2004 Spring Term, 2003 Spring Term, 2002 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206635>)

CEEN 6650 Bituminous Materials (3 credits)

Study of the behavior and properties of asphalt binders and hot mix asphalt pavement materials. The chemistry and rheological properties of asphalt binders with and without additives as well as the physical properties of aggregates are examined. Hot mix asphalt mix design methods are analyzed and laboratory testing of asphalt binders is conducted.

Level of Study: Graduate

Last four terms offered: 2016 Spring Term, 2006 Spring Term, 2003 Fall Term, 2001 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206650>)

CEEN 6655 Transportation Soils (3 credits)

Advanced study of surficial soils, soils variability, subgrade evaluation procedures, repeated loading behavior or soils and subgrade stability as used for constructing transportation facilities.

Prerequisite: CEEN 3320 and CEEN 3160 or equiv.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206655>)

CEEN 6660 Advanced Pavement Design (3 credits)

Advanced study of behavior and properties of highway and airfield pavements with emphasis on computer analysis of the stress-strain behavior under loading. Distress-specific performance expectations are developed for design pavement structures.

Prerequisite: CEEN 3160 and CEEN 3610; or equiv.

Level of Study: Graduate

Last four terms offered: 2016 Fall Term, 2008 Fall Term, 2007 Fall Term, 2006 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206660>)

CEEN 6675 Data Analysis and Visualization (3 credits)

Introduces analysis and visualization of engineering data sets, with a particular emphasis on transportation engineering data. Exploratory and explanatory analysis, data literacy, chart and color selection and storytelling with data. Tools covered include advanced Excel techniques, R and Python, and SQL. No prior computer programming experience required.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206675>)

CEEN 6840 Infrastructure Information Modeling (3 credits)

Infrastructure project lifecycle information generated during various stages of a project lifecycle. Computer modeling technologies used for managing project information. Relational data models. Relational representation of building information. Designing relational databases for efficient storage and management of infrastructure information. Object-created data models. Object-created analysis and design. Object-oriented representation of building information. Involves a project that accesses and integrates information from several sources such as a BIM model and other project resource databases for problem solving. Homework problems and course project are implemented in C# programming language.

Level of Study: Graduate

Last four terms offered: 2019 Spring Term, 2018 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206840>)

CEEN 6850 Temporary Structures in Construction (3 credits)

Investigates the design, safety analysis and economic considerations related to temporary structures used during construction. Topics covered include: construction and environmental loads, temporary earth retaining structures, cofferdams, construction dewatering, construction ramps and platforms, construction formwork, shoring and re-shoring in multistory concrete construction, scaffolding, bracing and guying for stability during construction.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206850>)

CEEN 6865 Biotechnology - Microbial Communities (3 credits)

Development of molecular methods with a focus on genomic approaches to characterize microbial community structure. Bioprocesses for waste management including anaerobic digestion, nitrification, denitrification, enhanced biological phosphorus removal, anammox and others. Concepts linking microbial community structure to process function, including functional resistance and resilience.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206865>)

CEEN 6932 Advanced Topics in Civil Engineering (1-3 credits)

Course content announced each term. Topics may include: structural optimization, design of structures for random loads, transportation systems analysis and design, water and wastewater systems analysis and design, and soil-structure interaction.

Level of Study: Graduate

Last four terms offered: 2021 Summer Term, 2021 Spring Term, 2018 Fall Term, 2016 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206932>)

CEEN 6953 Graduate Seminar in Civil Engineering (0-3 credits)

Review of current literature. Group discussion of recent work and current research by students and staff. 0 credit will be SNC/UNC grade assessment; 1-3 credits will be graded.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206953>)

CEEN 6995 Independent Study in Civil Engineering (1-3 credits)

Faculty-supervised, independent study/research of a specific area or topic in Civil Engineering.

Prerequisite: Cons. of instr. and cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Summer Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206995>)

CEEN 6999 Master's Thesis (1-6 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%206999>)

CEEN 8953 Doctoral Seminar in Civil Engineering (0-3 credits)

0 credit will be SNC/UNC grade assessment; 1-3 credits will be graded.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%208953>)

CEEN 8995 Independent Study in Civil Engineering (1-3 credits)

Faculty-supervised, independent study/research of a specific area or topic in Civil Engineering.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%208995>)

CEEN 8999 Doctoral Dissertation (1-12 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Summer Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%208999>)

CEEN 9970 Graduate Standing Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as less than half-time status only, cannot be used in conjunction with other courses, and does not qualify students for financial aid or loan deferment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2021 Spring Term, 2020 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209970>)

CEEN 9974 Graduate Fellowship: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term, 2021 Spring Term, 2020 Fall Term, 2017 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209974>)

CEEN 9975 Graduate Assistant Teaching: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209975>)

CEEN 9976 Graduate Assistant Research: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209976>)

CEEN 9984 Master's Comprehensive Examination Preparation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week toward their master's comprehensive exam.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Summer Term, 2015 Summer Term, 2015 Spring Term, 2012 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209984>)

CEEN 9985 Master's Comprehensive Examination Preparation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week toward their master's comprehensive exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Summer Term, 2012 Spring Term, 2009 Fall Term, 2009 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209985>)

CEEN 9986 Master's Comprehensive Examination Preparation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week toward their master's comprehensive exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Summer Term, 2016 Spring Term, 2015 Fall Term, 2013 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209986>)

CEEN 9987 Doctoral Qualifying Examination Preparation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week toward their doctoral qualifying exam.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Summer Term, 2012 Spring Term, 2009 Fall Term, 2009 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209987>)

CEEN 9988 Doctoral Qualifying Examination Preparation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week toward their doctoral qualifying exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2012 Spring Term, 2009 Fall Term, 2009 Summer Term, 2008 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209988>)

CEEN 9989 Doctoral Qualifying Examination Preparation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week toward their doctoral qualifying exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2019 Spring Term, 2018 Fall Term, 2018 Summer Term, 2016 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209989>)

CEEN 9994 Master's Thesis Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2021 Spring Term, 2020 Spring Term, 2018 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209994>)

CEEN 9995 Master's Thesis Continuation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Summer Term, 2018 Summer Term, 2018 Spring Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209995>)

CEEN 9996 Master's Thesis Continuation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Summer Term, 2023 Spring Term, 2022 Fall Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209996>)

CEEN 9997 Doctoral Dissertation Continuation: Less than Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Summer Term, 2022 Spring Term, 2018 Summer Term, 2012 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209997>)

CEEN 9998 Doctoral Dissertation Continuation: Half-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2018 Summer Term, 2012 Spring Term, 2010 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209998>)

CEEN 9999 Doctoral Dissertation Continuation: Full-Time (0 credits)

Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Fall Term, 2022 Summer Term, 2022 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=CEEN%209999>)