

**MASTER OF SCIENCE IN ENGINEERING (M.S.E.)
IN ENVIRONMENTAL ENGINEERING
Environmental and Water Resources Engineering Program
Department of Civil and Environmental Engineering
College of Engineering
The University of Michigan**

REQUIREMENTS AND PROCEDURES

These guidelines have been developed to assist graduate students working toward the M.S.E. degree in Environmental Engineering in planning a program of study that meets the requirements of that degree. Each student is responsible for planning such a study program, with the guidance of a faculty advisor from the Environmental and Water Resources Engineering (EWRE) program faculty:

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I. REGULATIONS

The basic requirements for the M.S.E. degree are established by the Horace H. Rackham School of Graduate Studies (referred to herein as the Graduate School). The faculty of the Department of Civil and Environmental Engineering has adopted certain additional requirements. The requirements, as they relate to the M.S.E. in Environmental Engineering degree, are described in these guidelines.

Each M.S.E. student must take personal responsibility for seeing that all requirements are met prior to the dates specified by the Graduate School. If special decisions or actions are needed, they should be initiated by the student in consultation with his or her faculty advisor and referred to the EWRE Graduate Program Advisor for action.

II. PROGRAM INFORMATION

A. Degree Offered

These guidelines are for the Master of Science in Engineering (M.S.E.) in Environmental Engineering, administered by the Environmental and Water Resources Engineering (EWRE) program in the Department of Civil and Environmental Engineering.

The purpose of the Environmental Engineering degree is to permit a higher level of specialization in Environmental Engineering than that achieved in an undergraduate degree. The Environmental and Water Resources Engineering (EWRE) program also offers the degree of M.S.E. in Civil Engineering with a specialization in Hydraulics and Hydrology. Students interested in this program should consult the separate M.S.E. in Civil Engineering guidelines.

B. Admission

To be granted admission to the M.S.E. in Environmental Engineering degree program, an applicant normally holds a B.S. degree in a traditional engineering discipline (e.g., civil, chemical, environmental, mechanical, etc.) and has attained an undergraduate grade point average (GPA) of at least 3.3/4.0. Students holding B.S. degrees in another engineering discipline, or a physical, chemical or biological science, may be admitted if they have achieved the technical background necessary to pursue advanced work in Environmental and Water Resources Engineering. **This background includes three semesters of calculus, ordinary differential equations (ODEs), a semester of calculus-based physics, a semester of college chemistry, a semester of fluid mechanics, problem-solving work using computers, and some background in environmental process engineering.** Students should have completed these requirements *prior to applying*. However, the requirements of ODEs, fluid mechanics, and exposure to environmental process engineering can be completed by taking the courses below *in the first offering of the course after enrollment for the M.S.E. degree*.

MATH 216	Differential Equations
CEE 325	Fluid Mechanics
CEE 465	Environmental Process Engineering

It is necessary to obtain a grade of “B” or better in each of these courses. None of the courses listed above may be used for graduate credit.

Completion of the Graduate Record Examination (GRE) is also required for an application to be considered.

C. General Requirements and Policies

1. Credit Hours

A minimum of 30 credit hours of approved graduate work must be completed for the M.S.E. in Environmental Engineering degree. According to the Graduate School guidelines, a student must register for a minimum of nine credit hours to be considered a full-time student. Nine to twelve credit hours per term is the usual full-time graduate course load. Graduate students with research or teaching appointments must carry a minimum of six credit hours per term.

2. Grades

The average grade for all graduate level courses taken while enrolled in the Graduate School and for the 30 credit hours used to fulfill the credit-hour requirement must be at least B, which is equivalent to a grade point average (GPA) of 3.0. A course in which a grade lower than C is obtained is not counted toward the satisfaction of degree requirements, but it is considered in the computation of the overall GPA.

3. Thesis

A thesis is not required, but up to 6 credit hours of research can be used toward the 30-credit hour degree requirement by electing CEE 921 Hydraulics and Hydrological Engineering Research or CEE 980 Research in Environmental Engineering. To register for either CEE 921 or CEE 980, the student must have a faculty sponsor and have worked out the details of what will be accomplished with that faculty member.

4. *Language*

Proficiency in the English language, both spoken and written, is expected. There is no requirement for proficiency in any other language.

5. *Comprehensive Examination*

Comprehensive examinations are not required of M.S.E. students.

6. *Residence Requirements*

The Graduate School residence requirements are satisfied by full-time students being enrolled for one or more semesters. Students pursuing the M.S.E. in Environmental Engineering degree on a part-time basis should become familiar with special requirements relating to part-time enrollment. See the website of the Graduate School at: <https://rackham.umich.edu/policy/section5/>

7. *Time Limit*

A student must complete all work within a period of five consecutive years after first enrollment in the Graduate School.

8. *Transfer Credits*

The Graduate School guidelines permit transfer of up to half of the 30 credit hours required for the M.S.E. in Environmental Engineering degree from inter-university and intra-university sources combined, according to the following rules:

a. *Graduate Credit*

A maximum of 6 credit hours of graduate credit may be transferred from another institution. These must be approved graduate-level courses completed while enrolled in a degree program with a grade of B or better from an accredited institution approved by the Graduate School. Graduate extension courses will be considered only from The University of Michigan, Wayne State University, Michigan State University, Western Michigan University, Central Michigan University, Eastern Michigan University, Northern Michigan University and Oakland University. Considerations of credit transfer will be made only upon written application of the student to the Graduate School through the Department of Civil and Environmental Engineering, and only after the student has established an overall graduate grade point average of B or better in resident work. Courses cannot be transferred for credit if already applied toward another degree, or if taken more than five years before beginning of graduate study at The University of Michigan.

b. *Pre-graduate Credit*

Credit for courses taken by the student with a grade of B or better earned during the senior year in The University of Michigan's College of Engineering may be included in the student's graduate study program subject to the following: (1) credit was not used to meet the bachelor's degree requirement, either as required coursework or as required credit hours, (2) credit was earned no more than two years before formal admission to the Graduate School and (3) credit was earned in courses approved for graduate credit by the Graduate School. The student may request the transfer of such credits through the Department of Civil and Environmental Engineering any time after admission.

D. Study Program

Students need to meet with their faculty advisor to plan a program of study prior to starting their first semester of coursework. A Program of Study Form (last page) must be submitted to the EWRE Graduate Program Advisor for approval before the sixth week of the student's first semester of enrollment. Prior approval of the plan must be obtained from the student's faculty advisor. The EWRE Graduate Program Advisor must approve any subsequent changes to the study plan before the alternate coursework is completed.

A minimum of *18 credit hours* of the total 30 credit hours required for the M.S.E. in Environmental Engineering must be elected from courses offered by the Department of Civil and Environmental Engineering. To provide breadth in the fundamentals of environmental engineering, students must complete the following three core classes (*9 credit hours*):

- CEE 581 Aquatic Chemistry
- CEE 582 Environmental Microbiology
- CEE 591 Environmental Fluid Mechanics

If students have completed coursework equivalent to any of the above core courses before entering the Program, courses in any of the Majors described below may be substituted in consultation with the student's faculty advisor.

An additional *12 credit hours* must be selected in one of the following areas of study, or "Majors":

- Ecohydrology
- Sustainable Energy Systems
- Water Quality Process Engineering
- Water Quality and Resources Engineering

The courses that may be selected to fulfill the Majors are listed in Table 1. If a student has already completed coursework equivalent to one or more courses listed in their chosen Major, with a grade of B or better, the Major can be satisfied with 9 credit hours of coursework, but not research. CEE 421 Hydrology and Floodplain Hydraulics is a prerequisite for the Ecohydrology major. CEE 480 Design of Environmental Engineering Systems is a prerequisite for the other three majors. If the prerequisite for a major has not been taken previously, it must be taken and can be used to fulfill an elective in the major with a grade of B or better. CEE 421 requires additional work (to be worked out with the instructor in advance) to be counted for graduate credit.

Up to six credit hours of research in hydraulics/hydrology (CEE 921) or environmental engineering (CEE 980) may be applied toward the degree. Enrollment in CEE 921 or CEE 980 can substitute for up to three credit hours of the coursework in the Major, but not the courses required for the Major. New M.S.E. students must complete an introductory seminar, CEE 881 (*1 credit hour*), in the first fall semester of the student's program. This is the only seminar credit that can be counted toward the degree. Registration in and attendance at CEE 880, the Program's seminar series, is required during each winter semester for all enrolled M.S.E. students. CEE 880 credit hours may not be counted towards the degree.

A minimum of *8 credit hours* of elective coursework related to the degree is required. Any course listed as part of a major is acceptable as an elective. Students also often take graduate level courses elsewhere in CEE, the College of Engineering, School of Environment and Sustainability (SEAS) and Ross School of Business as electives. The degree also stipulates a student must complete at least one course (minimum *3 credit hours*) in mathematics, probability, statistics, or mathematical programming, taught at a level consistent with a prerequisite of Math 215 (Calculus III). Table 2 provides a list of approved math courses. The elective coursework must include at least *3 credit hours* of cognate coursework; i.e., coursework related to the field of specialization taken outside of Civil and Environmental Engineering. Courses used to fill the cognate requirement must be a minimum of two credit hours. If a student takes a math course or a course outside of CEE as part of the requirements for fulfilling a major, this course, provided that it is at least *3 credit hours*, can also be used to fulfill the cognate requirement.

A 400-level course may be elected for graduate credit if the course is eligible for graduate credit. Within Civil and Environmental Engineering, *the following 400-level courses are eligible for graduate credit toward degrees in Environmental Engineering: CEE 428, CEE 446, and CEE 480. CEE 421 is also eligible with additional work that needs to be worked out in advance with the course instructor.* Of all the 400-level courses elected, no more than a total of 12 credit hours, and no more than 9 credit hours of 400-level Civil and Environmental Engineering courses, will be accepted towards the degree.

Table 1. Courses Constituting the “Majors” (12 credit hours)

Ecohydrology*

Choose four:

- CEE 428 Groundwater Hydrology
- CEE 520 Physical Processes of Land-Surface Hydrology
- CEE 521 Open Channel Flow
- CEE 522 Sediment Transport
- CEE 524 Environmental Turbulence
- CEE 526 Design of Hydraulic Systems
- CEE 527 Coastal Hydraulics
- CEE 573 Data Analysis
- CEE 590 Stream, Lake, and Estuary Analysis
- CEE 593 Environmental Soil Physics
- CEE 624 Restoration Fundamentals & Practice in Aquatic Systems

*CEE 421 must be completed if an equivalent course has not been taken.

Water Quality Process Engineering^a

Required:

- CEE 580 Physical Chemical Processes in Environmental Engineering
- CEE 592 Biological Processes in Environmental Engineering

Choose two:

- CEE 428 Groundwater Hydrology
- CEE 568 Decentralized Water Supply, Hygiene, and Sanitation
- CEE 573 Data Analysis
- CEE 593 Environmental Soil Physics
- CEE 594 Environmental Soil Chemistry
- CEE 597 Environmental Organic Chemistry
- CEE 693 Environmental Molecular Biology
- Approved BIOLCHEM, CHE, CHEM or CLIMATE elective^a

^aCEE 480 must be completed if an equivalent course has not been taken. It can serve as an elective in the Major.

^aOnly one BIOLCHEM, CHE, CHEM, or CLIMATE course from approved list (see Table 3) may be selected as part of the Major.

Sustainable Energy Systems[#]

Required:

- CEE 567 Energy Infrastructure Systems

Choose three of the following:

- CEE 526 Design of Hydraulic Systems
- CEE 549 Geoenvironmental Engineering
- CEE 555 Sustainability of Civil Infrastructure Systems
- CEE 563 Air Quality Engineering Fundamentals
- CEE 564 Greenhouse Gas Control
- CEE 592 Biological Processes in Environmental Engineering

Approved CEE, CHE, EAS, EECS, EHS, MECHENG or NERS elective[†]

[#]CEE 480 must be completed if an equivalent course has not been taken. It can be serve as an elective in the Major.

[†]Only one CEE, CHE, EAS, EECS, EHS, MECHENG or NERS course from approved list (see Table 4) may be selected as a Major course from approved list.

Water Quality and Resources Engineering^a

Choose at least one:

- CEE 521 Open Channel Flow
- CEE 522 Sediment Transport

Choose at least one:

- CEE 580 Physical Chemical Processes in Environmental Engineering
- CEE 592 Biological Processes in Environmental Engineering

Choose up to two:

- CEE 428 Groundwater Hydrology
- CEE 520 Physical Processes of Land-Surface Hydrology
- CEE 524 Environmental Turbulence
- CEE 526 Design of Hydraulic Systems
- CEE 568 Decentralized Water Supply, Hygiene, and Sanitation
- CEE 573 Data Analysis
- CEE 597 Environmental Organic Chemistry
- CEE 624 Restoration Fundamentals & Practice in Aquatic Systems

^aCEE 480 must be completed if an equivalent course has not been taken. It can serve as an elective in the Major.

Table 2. Courses Satisfying the Math Requirement

BIOSTAT 601 Probability and Distribution Theory
CEE 573 Data Analysis in Civil and Environmental Engineering [§]
IOE 565 Analysis of Time Series
MATH 450 Advanced Math for Engineers I
MATH 454 Boundary Value Problems for Partial Differential Equations
MATH 462 Mathematical Modeling
MATH 463 Mathematical Modeling in Biology
MATH 471 Introduction to Numerical Methods
MATH 571 Numerical Methods for Scientific Computing I
MATH 572 Numerical Methods for Scientific Computing II
STAT 500 Applied Statistics I – Linear Regression Models
STAT 503 Applied Multivariate Analysis
STAT 531/Econ 677 Analysis of Time Series
Any other 500 level MATH or STAT course

[§]CEE 573 Data Analysis may be used to satisfy the Math requirement or as a “Major” course in particular majors, but it may not be used to satisfy both.

Table 3. Approved Water Quality Process Engineering Electives*

BIOCHEM 515 Introductory Biochemistry
CHE 470 Colloids and Interfaces
CHE 543 Advanced Separation Processes
CHEM 420 Intermediate Organic Chemistry
CLIMATE 467 Biogeochemical Cycles

*Only one of these courses may be counted towards the Water Quality Process Engineering major.

Table 4. Approved Sustainable Energy Systems Electives⁺

CEE 586 (EAS 557)	Industrial Ecology
CEE 588	Sustainable Finance
CHE 548	Electrochemical Engineering
CHE 568	Fuel Cells and Fuel Processors
EAS 527 (BE 527)	Energy Markets and Energy Politics
EAS 574 (ESENG 599)	Sustainable Energy Systems
EAS 597	Environmental Systems Analysis
EECS 418	Power Electronics
EECS 419	Electric Machinery and Drives
EECS 463	Power System Design and Operation
EECS 498	Grid Integration of Alternative Energy Sources
EECS 598	Infrastructure for Vehicle Electrification
EHS 540	Sustainability and Environmental Health
MECHENG 433	Advanced Energy Solutions
MECHENG 571	Energy Generation and Storage Using Modern Materials
MECHENG 589	Sustainable Design of Technology Systems
NERS 531	Nuclear Waste Management

⁺Only one of these courses may be counted towards the Sustainable Energy Systems major.

Student's Name: _____

	Semester				Cognate ✓	Math ✓	Credit Hours
	F	W	F	W			
Core (9 credit hours)							
1. CEE 581							3
2. CEE 582							3
3. CEE 591							3
Major - _____ (min 12 credit hours)							
1.							
2.							
3.							
4.							
Electives (min 8 credit hours)							
1.							
2.							
3.							
Seminars							
1. CEE 880 (each Winter term of enrollment)		x		x			0
2. CEE 881 (first Fall term)	x						1

Cognate (total at least 3 credit hours): Advanced Math (total at least 3 credit hours)

At least 18 credit hours of CEE courses. No more than 9 credit hours of 400-level CEE courses. No more than 12 credit hours of 400-level courses in total.

Check here if you are a SGUS student _____. Please attach your approved SGUS form.

Faculty Advisor: _____(signature) Date: _____

EWRE Graduate Advisor: _____(signature) Date: _____