



## **MASTER OF SCIENCE IN ENGINEERING (MSE) IN ENVIRONMENTAL ENGINEERING REQUIREMENTS AND PROCEDURES**

The purpose of the MSE degree in Environmental Engineering 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 MSE in Civil Engineering with a specialization in Hydraulics and Hydrology. Students interested in this program should consult the separate MSE in Civil Engineering guidelines.

These guidelines have been developed to assist graduate students working toward the MSE 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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### **1. REGULATIONS**

The basic requirements for the MSE 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 MSE in Environmental Engineering degree, are described in these guidelines.

Each MSE student must take personal responsibility for seeing that all requirements are met prior to the graduation deadline specified by the Rackham Graduate School. These deadlines may be found at <https://rackham.umich.edu/navigating-your-degree/apply-for-graduation/>.

If special decisions or actions are needed, they should be initiated by the student in consultation with their faculty advisor and referred to the EWRE Graduate Program Advisor for action.

### **2. PROGRAM INFORMATION**

#### **2.1. Admission and Prerequisites**

To be granted admission to the MSE in Environmental Engineering degree program, an applicant normally holds a BSE 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 field, may be admitted if they have achieved the technical background necessary to pursue advanced work in Environmental 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*.

Prerequisite topic	UM courses
Ordinary Differential Equation	MATH 216
Fluid Mechanics	CEE 325
Environmental Process Engineering	CEE 465

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

## 2.2. General Requirements and Policies

### 2.2.1. Credit Hours

A minimum of 30 credit hours of approved graduate work must be completed for the MSE in Environmental Engineering degree. According to the Graduate School guidelines, a student must register for a minimum of nine credit hours per semester 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.

Note that some U.S. government agencies, such as the Veterans Administration and the U.S. Citizenship and Immigration Services, may require a student to be enrolled for a different minimum number of credit hours to be considered a full-time student. International students must be enrolled full-time under requirements set by the U.S. Citizenship and Immigration Services, and on F-1 or J-1 visas should consult the International Center with any questions concerning enrollment, course registration, and visa status. International students who wish to be registered less than full-time must obtain permission in advance from the International Center or risk compromising their visa status.

### 2.2.2. Grades and GPA

A grade point average (GPA) of at least 3.0 must be maintained for graduate level courses taken while enrolled in the Graduate School, and for the 30 credit hours used to fulfill the credit-hour requirement. Failure to do so will result in being placed on probation. A course in which a grade lower than C is obtained may not be counted toward the satisfaction of any degree requirements, but it is considered in the computation of the overall GPA.

### 2.2.3. Thesis or non-thesis research

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.

### 2.2.4. Language

Proficiency in the English language, both spoken and written, is expected. There is no requirement for proficiency in any other language. MSE applicants whose native language is not English must demonstrate English proficiency by following Graduate School guidelines (<https://rackham.umich.edu/admissions/applying/tests/>).

### 2.2.5. Residency Requirements

The Graduate School residency requirements are satisfied by full-time students being enrolled for two or more semesters. Students pursuing the MSE 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/>

### 2.2.6. Time Limit

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

### 2.2.7. Transfer Credits

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

#### 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. 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 the beginning of graduate study at U-M .

#### Pre-graduate Credit

Credit for courses taken by the student with a grade of B or better earned while an undergraduate in the U-M College of Engineering may be included in the student's graduate study program subject to the following: (1) credit was not used to meet any bachelor's degree requirement (including minors), (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 after they have established an overall graduate grade point average of B or better in resident work.

### 2.2.8: Sequential Undergraduate-Graduate Studies (SUGS)

SUGS students with undergraduate specialization in any area of CEE may pursue an MSE degree in Environmental Engineering. SUGS students are permitted to double count up to 6 credit hours, provided that (1) these credit hours are obtained with courses approved for graduate credit by the Graduate School, for which the student has received a grade of B or better, and (s) that they satisfy the requirements of the Program of Study as indicated in Section 2.3.

### 2.2.9: Diploma

To be considered and to be formally awarded the MSE in Environmental Engineering degree diploma, a student must apply to graduate in Wolverine Access by the graduation application deadline, which may be found on the Rackham Graduate School website at <https://rackham.umich.edu/navigating-your-degree/apply-for-graduation/>.

### 2.3. Program of Study

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 (Appendix 2) must be submitted to the EWRE Graduate Program Advisor for approval before the end of the second 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.

The Program of Study will vary for each student, depending on their interests and the courses being offered in a given year. However, each Program of Study must meet the following requirements:

- A minimum of 18 credit hours of the total 30 credit hours required for the MSE in Environmental Engineering must be courses offered by the Department of Civil and Environmental Engineering.
- To provide breadth in the fundamentals of environmental engineering, students must take at least *one course from two of the following three core categories (6 credits)*: C – Environmental Chemical Sciences, B – Environmental Biological Sciences, P – Environmental Physical Sciences:
  - C: CEE 581 or CEE 597
  - B: CEE 582 or CEE 693
  - P: CEE 591 or CEE 590 or CEE 521

For example, a student could select to take CEE 581 and CEE 582 to meet this requirement. 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":
  - Environmental Process Engineering
  - Energy, Climate, and Air Quality
  - Environmental Data Systems and Finance
  - Ecohydrology and Environmental Fluid Mechanics

The courses that may be selected to fulfill the Majors are listed in Appendix 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 nine credit hours of coursework, but not research. CEE 421 Hydrology and Floodplain Hydraulics is a prerequisite for the Ecohydrology and Environmental Fluid Mechanics major. 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 *11 credit hours* of elective coursework related to the degree is required. Any course

listed as part of a major is also acceptable as an elective. Students also often take graduate level courses elsewhere in CEE, the College of Engineering, or in other units such as the School of Environment and Sustainability (SEAS) and Ross School of Business as electives.

- 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 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.

## **Appendix 1: MSE Majors Guidelines**

**A total of 30 credit hours are required to complete the Environmental Engineering M.S.E. degree.**

**Each M.S.E. student must take the following seminar courses**

- CEE 881 (during their first fall semester, 1 credit)
- CEE 880 (each winter semester student is enrolled, NFC)

### **Environmental Engineering Core Courses**

**Must take *at least one course from two of three core categories (6 credits)***

- C: CEE 581 or CEE 597
- B: CEE 582 or CEE 693
- P: CEE 591 or CEE 590 or CEE 521

One Major or Elective course selection must be listed with a C, B, or P designation, whichever is not taken for the two core course elections. These designations indicate the course content has a significant emphasis on chemical (C), biological (B), or physical (P) science and/or processes. For example, if a student selects CEE 581 and CEE 582 as their courses to meet the requirements for the core in environmental engineering, they need to take at least one course with a P designation as part of their major or elective courses (e.g., CEE 580).

### **Note regarding research/independent study credit**

Up to six credit hours of CEE 980 or CEE 921 can be taken as part of the MSE-required credit hours.

### **Major Area 1: Environmental Process Engineering**

\*If selecting this major, it is *recommended* that students take CEE 581 as one of their core courses or electives

**Must take two of the following courses (6 credits)**

- CEE 580 Physical Chemical Processes in Environmental Engineering (C, P)
- CEE 592 Biological Processes in Environmental Engineering (B)
- CEE 563 Air Quality Engineering Fundamentals (P)

**Must take two of the following courses (6 credits)**

- CEE 428 Groundwater Hydrology (P)
- CEE 501.x Adapting to water scarcity: design of advanced treatment systems (C, P)
- CEE 520 Physical Processes of Land-Surface Hydrology (P)
- CEE 568 Decentralized Water Supply, Hygiene, and Sanitation
- CEE 501 Engineering Solutions to Drinking Water Challenges (\*new course number soon)
- CEE 573 Data Analysis in CEE
- CEE 597 Environmental Organic Chemistry (C)
- CEE 624 Restoration Fundamentals & Practice in Aquatic Systems
- CEE 693 Environmental Molecular Biology (B)
- CEE 980 Research in Environmental Engineering (directed study related to Major)

**Recommended electives (min of 11 credits)**

- Any of the above courses not yet taken
- BiolChem 550 Intro to Biochemistry
- ChE 496/ChE 696 Metabolic and Microbiome Engineering
- ChE 540 Mathematical Methods for Biological Network Analysis

BIOINF 527 Introduction to Bioinformatics & Computational Biology  
 EARTH 523 Microbial Community Omics  
 EEB 446 Microbial Ecology  
 EEB 447 Microbes in the Wild: Environmental Microbiology Laboratory  
 EPID 582 Molecular Epidemiology  
 CLIMATE 466 Carbon – Climate Interactions  
 CEE 587 (NRE 558) Water Resource Policy  
 CEE 589 (NRE 595) Risk and Benefit Analysis in Environmental Engineering  
 CEE 575 Sensors, Data, and Intelligent Systems  
 EHS 674 Environmental and Health Risk Monitoring  
 EHS 608 Environmental Epidemiology  
 MICRBIOL 612  
 MECHENG 589 - Sustainable Design of Technological Systems

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**Major Area 2: Energy, Climate, and Air Quality**

**Must take two of the following courses (min 6 credits):**

CEE 563 Air Quality Engineering Fundamentals (P)  
 CEE 564 / ESENG 535 Greenhouse Gas Control (P)  
 CEE 567 / ESENG 567 Energy Infrastructure Systems (P)

**Must take one of the following courses, or a third course from the list above (min 3 credits):**

CEE 428 Groundwater Hydrology (P)  
 CEE 526 Design of Hydraulic Systems (P)  
 CEE 555 Sustainability of Civil Infrastructure Systems  
 CEE 575 Sensors, Data, and Intelligent Systems  
 CEE 588 / CHE 590 Sustainability Finance: Investment Models for Green Growth  
 CEE 592 Biological Processes in Environmental Engineering (B)  
 CEE 597 Environmental Organic Chemistry (C)  
 CEE 980 Research in Environmental Engineering (directed study related to Major)

**Recommended electives (min of 3 credits)**

Any of the above courses not yet taken

APPPHYS 524 / EECS 524 Organic Electronic Devices and Applications  
 BE 527 / EAS 527 Energy Markets and Energy Politics  
 CEE 565 / ESENG 501 Seminars on Energy Systems Technology and Policy  
 CEE 586 / EAS 557 Industrial Ecology  
 CLIMATE 463 Air Pollution Meteorology  
 CLIMATE 466 Carbon-Climate Interaction  
 CLIMATE 473 Climate Physics (P)  
 CLIMATE 479 Atmospheric Chemistry (C)  
 CLIMATE 480 / EAS 480 Climate Change: The Move to Action  
 EARTH 529 / NERS 531 Nuclear Waste Management  
 EAS 525 Energy Justice  
 EAS 555 Climate and Development  
 EAS 573 Environmental Footprinting and Input-Output Analysis  
 EAS 574 / ESENG 532 Sustainable Energy Systems  
 EAS 575 Climate Economics and Policy  
 EAS 597 Environmental Systems Analysis

EAS 605	Green Development
EAS 615	Renewable Electricity and the Grid
EAS 686 / PUBPOL 563	Environmental Policy
EECS 418	Power Electronics
EECS 419	Electric Machinery and Drives
EECS 421	Properties of Transistors
EECS 429	Semiconductor Optoelectronic Devices
EECS 463	Power System Design and Operation
EECS 534	Distribution Systems
EECS 535	Power Systems Dynamics and Control
EECS 536	Power Markets
EHS 540	Sustainability and Environmental Health
ESENG 505 / MECHENG 571	Energy Generation and Storage Using Modern Materials
MATSCIE 545	Fundamentals of Battery Design
MECHENG 589	Sustainable Engineering and Design
NERS 524	Nuclear Fuels
NERS 546	Thermal Fluids for Nuclear Reactor Safety Analysis

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**Major Area 3: Environmental Data Systems and Finance**

**Must take one course from all three core course categories (one will count toward Major) (3 credits):**

C: CEE 581 or CEE 597

B: CEE 582 or CEE 693

P: CEE 591 or CEE 590 or CEE 521

**Must take (3 credits):**

CEE 573 Data Analysis in Civil and Environmental Engineering

(\*confer with Graduate Program Advisor if CEE 573 is not offered during your term of study to find an alternative course to satisfy this requirement)

**Must take one of the following courses (3 credits):**

EECS 545 Machine Learning (CSE)

EECS 553 Machine Learning (ECE)

**Must take one of the following courses (3 credits)**

CEE 504 Engineering Economics and Finance

CEE 553 Infrastructure Systems Optimization

CEE 555 Sustainability of Civil Infrastructure Systems

**Recommended Electives (min. 11 credits)**

CEE 428 Groundwater Hydrology (P)

CEE 500 Environmental Systems and Processes I



CEE 501.004 Infrastructure Project Finance (\*new course number coming soon)  
CEE 504 Engineering Economics and Finance  
CEE 520 Physical Processes of Land-Surface Hydrology (P)  
CEE 553 Infrastructure Systems Optimization  
CEE 555 Sustainability of Civil Infrastructure Systems  
CEE 563 Air Quality Engineering Fundamentals (P)  
CEE 567 Energy Infrastructure Systems (P)  
CEE 568 Decentralized Water Supply, Hygiene and Sanitation  
CEE 575 Sensors, Data, and Intelligent Systems  
CEE 580 Physicochemical Processes in Environmental Engineering (C, P)  
CEE 588 (CHE 590) Sustainability Finance: Investment Models for Green Growth  
CEE 590 Stream, Lake, and Estuary Analysis (P)  
CEE 592 Biological Processes in Environmental Engineering (B)  
IOE 512 Dynamic Programming  
IOE 515 Stochastic Processes  
IOE 561 (ISD 523) Risk Analysis I  
IOE 574 Simulation Design and Analysis

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**Major Area 4: Ecohydrology and Environmental Fluid Mechanics**

\*If selecting this major, it is *required* that students take CEE 591 as one of their core courses or electives

***Must take one of the following courses:***

CEE 573 Data Analysis in CEE  
AEROSP 523 Computational Fluid Dynamics I

***Must take one of the following courses:***

CEE 428 Groundwater Hydrology (P)  
CEE 520 Physical Processes of Land-Surface Hydrology (P)  
CEE 590 Stream, Lake, and Estuary Analysis (P)

***Must take two of the following courses:***

Any of the above courses not yet taken  
CEE 501 Tsunamis, Hurricanes and Floods  
CEE 521 Open Channel Flow (P)  
CEE 522 Sediment Transport (P)  
CEE 524 Restoration Fundamentals  
CEE 526 Design of Hydraulic Systems (P)  
CEE 563 Air Quality Engineering Fundamentals

**Appendix 2: Student Plan of Study**

Student's Name: \_\_\_\_\_

	Semester				Credit Hours
	F ____	W ____	F ____	W ____	
<b>Core (6 credit hours)</b>					
1.					3
2.					3
<b>Major - _____ (min 12 credit hours)</b>					
1.					
2.					
3.					
4.					
<b>Electives (min 11 credit hours)</b>					
1.					
2.					
3.					
<b>Seminars</b>					
1. CEE 880 (each Winter term of enrollment)		x		x	0
2. CEE 881 (first Fall term)	x				1

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: \_\_\_\_\_