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.

<table>
<thead>
<tr>
<th>Prerequisite topic</th>
<th>UM courses</th>
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<tbody>
<tr>
<td>Ordinary Differential Equation</td>
<td>MATH 216</td>
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<tr>
<td>Fluid Mechanics</td>
<td>CEE 325</td>
</tr>
<tr>
<td>Environmental Process Engineering</td>
<td>CEE 465</td>
</tr>
</tbody>
</table>

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

**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
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

**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: ___________________________________________

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<tr>
<th>Core (6 credit hours)</th>
<th>Semester</th>
<th>Credit Hours</th>
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<th>Major - ________________ (min 12 credit hours)</th>
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<th>Electives (min 11 credit hours)</th>
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<tr>
<th>Seminars</th>
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<tr>
<td>1. CEE 880 (each Winter term of enrollment)</td>
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<td>2. CEE 881 (first Fall term)</td>
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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: ____________