

MS and PhD Degree Requirements

Environmental Engineering Specialization

Civil, Environmental and Sustainable Engineering (CESE) Graduate Program

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Background

The Environmental Engineering specialization in the Civil, Environmental and Sustainable Engineering (CESE) graduate program explores physical, chemical, and microbiological processes occurring in the natural and built environment and incorporates principles of sustainable engineering. The program emphasizes important issues facing society including water scarcity and emerging pollutants.

Environmental Engineering Faculty

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1. Graduate College Admissions Classifications

The CESE graduate program, in the School of Sustainable Engineering and the Built Environment (SSEBE), follows the admissions classifications as outlined by the ASU Graduate College in the Graduate Catalog.

Regular Admission: A student who fulfills all requirements for admission and is academically acceptable to the academic unit and the Graduate College is granted regular admission.

Regular Admission with Deficiencies: A student whose grades and test scores are at an acceptable level, but who does not have the undergraduate background expected by the academic unit and the university may be required to complete courses to remedy deficiencies. Deficiency courses must be completed before the student is awarded a graduate degree. Deficiency courses may not be applied toward the minimum credit hours required for the degree program.

Provisional Admission: A student who does not meet the minimum academic standards but has counterbalancing evidence to suggest the potential for success may be admitted on a provisional basis. Provisional admission provides an academic unit with more evidence on which to base its decision. Normally the academic unit reviews the student's status following completion of 12 credit hours of approved graduate study. At that time, the academic unit recommends to the Graduate College a change in status to either regular admission or withdrawal from the program. After a student has completed all provisional requirements, they should check with a department academic advisor to make sure that the change of status has been completed. A provisional student may also be assigned deficiencies.

2. Environmental Engineering Specialization

2.1. Admissions

If a student does not have an undergraduate degree in Environmental Engineering, Civil Engineering, or related engineering discipline is admitted, the student will be admitted "Regular Admission with Deficiencies" and will be required to take appropriate undergraduate courses to establish a knowledge base in the discipline. Typically, a student must complete or have equivalent credit for all of the mathematics, chemistry, and physics courses required in the [B.S.E. degree in Environmental Engineering \(EVE\)](#) at ASU.

For the Environmental Engineering specialization, the student must complete or have equivalent credit for the following courses:

- CEE 341 Fluid Mechanics for Civil Engineers
- CEE 361 Introduction to Environmental Engineering

Other possible deficiency courses include CHM 114 General Chemistry for Engineers. The required deficiency courses are determined by the Specialty Area Coordinator for Environmental Engineering upon admission to the program. Deficiency courses must be taken for a letter grade.

A cumulative GPA of 3.0 or higher is required in all courses taken as deficiency or required courses for the graduate program. A student is placed on academic probation and given the following semester (9 credit hours) to raise their cumulative GPA to 3.0 or higher. A student can be recommended for dismissal from the program if they are not successful in raising their GPA.

A student who marginally meets the admission standards or who has more than 6 credit hours of deficiencies may be recommended for Provisional Admission. All requirements specified in the

Provisional Admission must be met and the student's status officially changed to Regular Admission status prior to completion of a graduate Interactive Program of Study (iPOS).

2.2. Graduate Supervisory Committee (GSC)

For MS students following the *thesis option*, the faculty advisor/thesis chair normally acts as chair of the student's Graduate Supervisory Committee (GSC). For MS students following the *non-thesis option*, the Specialty Area Coordinator for Environmental Engineering normally acts as the chair of the student's GSC. See **section 2.4** below for additional details. The chair of the GSC must be a tenure or tenure-track faculty member in the CESE program in SSEBE. If necessary, a co-chair from another program may be added to the committee. Permission must be granted from the Graduate College to approve a non-SSEBE faculty member to serve as a co-chair on a student's GSC. A student must submit a Committee Approval form to have a non-SSEBE faculty member approved to serve as a co-chair; the form can be completed by emailing a SSEBE graduate advisor. An emeritus professor from SSEBE may also serve as a co-chair. The chair will assist the student in the selection of other faculty members for the GSC. For the *MS thesis option*, a minimum of three (3) members, including the chair, are required to form the GSC and at least half of the committee members must be tenure/tenure-track faculty in the CESE program in SSEBE. The committee should be selected and approved prior to taking the Final Comprehensive Exam (MS student) or Comprehensive Qualifying Exam (PhD student).

See **PhD Qualifying Exam Requirements, Environmental Engineering Specialization, Civil, Environmental and Sustainable Engineering (CESE) Graduate Program** for guidance on forming the GSC for PhD students. This document is available from SSEBE graduate advising and the Specialty Area Coordinator for Environmental Engineering.

The *Graduate Supervisory Committee Change* form is used to request a change, from the Graduate College, to the approved GSC. Any committee member, including the chair, can be changed by completion of this form with the appropriate approvals. This is done through the iPOS by submitting a committee change request.

2.3. Interactive Program of Study (iPOS)

A graduate Interactive Program of Study (iPOS) must be filed with the Graduate College *before* registration for the third semester or *before* completion of 15 graduate credit hours, whichever comes first. For MS students, the iPOS must be submitted by the end of the first semester. The iPOS is a formal plan for all courses to be taken by the student and is an agreement that those courses will be sufficient for the desired degree. The chair of the student's GSC must approve the iPOS. For non-thesis (i.e., coursework-only) MS students, the iPOS is approved by the Specialty Area Coordinator for Environmental Engineering. The student must have Regular Admission status when filing the iPOS. An iPOS can only be submitted online through myASU.

Without an iPOS submitted, a student may be blocked from registering for the next semester. If a student is graduating and/or defending in the upcoming semester, then the student will not be able to register until an iPOS has been submitted. Processing time for an iPOS can take up to four months. The student will receive an email from the Graduate College when the iPOS is approved. Without an approved iPOS, a student cannot complete the comprehensive exam or

graduate. Changes to an approved iPOS can be completed by going to myASU and making the necessary changes.

2.4. Degree Options and Course Requirements

The MS degree requires 30 credit hours for completion of the thesis and non-thesis options. An MS student can transfer a total of 12 credit hours from another graduate program. This is referred to as pre-admission credits and can be transferred from a graduate program for which a student did not complete a degree. While the iPOS should contain only 500-level graduate courses, up to two (2) approved 400-level courses (not available in CEE or EVE programs) totaling 6 credits may be included in the iPOS. (Note: 6 credit hours of 400-level courses can be included in the iPOS for MS students but cannot be included in the iPOS for PhD students.) A maximum of 3 credit hours of Reading and Conference (CEE 590) can be included in the iPOS as coursework for MS students. Students must be enrolled in at least 1 graduate-level credit hour during the semester or summer session in which they complete their MS degree program. To remain in the MS degree program, the student must maintain a cumulative GPA of 3.0 or higher. Students cannot graduate without a cumulative GPA of 3.0 or higher.

See **section 4** below for guidance on credit hour requirements for PhD students.

Thesis Option: The faculty advisor/chair (must be a tenure or tenure-track faculty in the CESE program in SSEBE) in consultation with the student will establish a GSC. The GSC shall be composed of a minimum of three (3) faculty members, including the chair, with at least two members being tenure or tenure-track faculty in the CESE program in SSEBE. The participation of individuals from institutions external to ASU is allowed. See **section 2.2** above on Graduate Supervisory Committee (GSC).

The iPOS must be in accordance with the Graduate College and CESE program requirements. This includes 24 credits of coursework and 6 credits of CEE 599 Thesis. CEE 590 Reading and Conference may be taken for up to 3 credits of coursework. A student can take CEE 590 with any tenure or tenure-track faculty member in the CESE program in SSEBE. A 1 credit seminar, CEE 591, can be repeated up to three times to count as 3 credits of coursework upon approval of the faculty advisor/chair.

Non-Thesis Option: The non-thesis option has two sub-options: (1) coursework-only and (2) applied project.

Sub-Option 1. Coursework Only: The Specialty Area Coordinator for Environmental Engineering shall serve as the chair of the GSC for the coursework-only sub-option. Three committee members are required for the GSC for the coursework-only sub-option. The other two committee members should be tenure/tenure-track faculty in the CESE program who taught core courses taken by the student. The iPOS must be in accordance with the Graduate College and CESE program requirements. This includes 30 credit hours of coursework including appropriate core classes as designated for the specialty area (see **section 3** below). CEE 590 Reading and Conference may be taken for up to 3 credits of coursework. A student can take CEE 590 with any tenure or tenure-track faculty member in the CESE program in SSEBE. A 1 credit seminar,

CEE 591, can be repeated up to three times to count as 3 credits of coursework upon approval of the faculty advisor/chair.

A final comprehensive exam is administered by the Specialty Area Coordinator for Environmental Engineering during the last semester of the degree program. The student is tested on concepts from selected core courses in the specialty area. A student should consult with the specialty area coordinator for specifics regarding the nature of the examination. Before taking the examination, the student must file an iPOS with the Graduate College. Examination results are sent to the Graduate College for recording. All comprehensive examination results, including failures, are reported.

Sub-Option 2. Applied Project: For the applied project sub-option, the faculty member who supervises the applied project is normally designated the GSC chair. Only one committee member, i.e., the applied project chair, is required for the GSC for the applied project sub-option. The iPOS must be in accordance with the Graduate College and CESE program requirements. This includes 27 credit hours of coursework, including appropriate core courses as designated for the specialty area (see **section 3** below), and 3 credits of CEE 593 Applied Project. CEE 593 may be taken for up to 3 credits, and a grade of B or higher must be achieved to graduate. CEE 590 Reading and Conference may be taken for up to 3 credits of coursework. A student can take CEE 590 with any tenure or tenure-track faculty member in the CESE program in SSEBE. A 1 credit seminar, CEE 591, can be repeated up to three times to count as 3 credits of coursework upon approval of the faculty advisor/chair.

A student completes an applied project under the supervision of a faculty member. The student is evaluated based on their written and/or oral communications skills exhibited in the final product associated with the applied project. The scope of work and final product for the applied project is determined by the faculty advisor and student before work begins on the applied project. If a student wants to do an applied project outside of the CESE program in SSEBE, then the student must add a CESE faculty member as co-chair on their iPOS.

3. Graduate Courses

3.1. Core Courses

Students pursuing the MS degree in CESE with specialization in Environmental Engineering are required to complete 4 core courses from the following list of courses:

- **CEE 506** Life Cycle Assessment for Civil Systems (typically offered spring semester)
- **CEE 560** Soil and Groundwater Remediation (typically offered spring semester)
- **CEE 561** Physical-Chemical Treatment of Water and Waste (typically offered spring semester)
- **CEE 562** Environmental Biochemistry and Waste Treatment (typically offered spring semester)
- **CEE 563** Environmental Engineering Chemistry (typically offered fall semester)
- **CEE 564** Contaminant Fate & Transport (typically offered fall semester)
- **CEE 567** Environmental Microbiology (typically offered fall semester)
- **CEE 569** Air Quality Engineering (typically offered fall semester)

A student can take more than 4 core courses if desired. Beyond the core course requirements, a student can take graduate courses within and outside of the CESE program to satisfy the credit requirements for coursework.

There are no core course requirements for PhD students. A PhD student should work with their advisor and GSC to determine appropriate courses.

3.2. Core Courses effective for incoming students Fall 2022 and thereafter

Students pursuing the MS degree in CESE with specialization in Environmental Engineering are required to complete the following 4 core courses:

- **CEE 561** Physical-Chemical Treatment of Water and Waste
- **CEE 562** Environmental Biochemistry and Waste Treatment
- **CEE 563** Environmental Engineering Chemistry
- **CEE 567** Environmental Microbiology

Students are also required to complete 2 of the following 4 courses:

- **CEE 560** Soil and Groundwater Remediation
- **CEE 564** Contaminant Fate and Transport
- **EVE 568** Environmental Risk Assessment
- **EVE 571** Water Quality Modeling

Beyond the core course requirements, a student can take graduate courses within and outside of the CESE program to satisfy the credit requirements for coursework.

There are no core course requirements for PhD students. A PhD student should work with their advisor and GSC to determine appropriate courses.

3.3. Course Options

Students pursuing the MS degree in the CESE program with specialization in Environmental Engineering may choose to organize their courses into one of the following focus areas: Environmental Biotechnology, Environmental Pollutants, or Water Science. The focus areas are optional, and the courses are provided as guidance with other courses available.

Environmental Biotechnology: The Environmental Biotechnology focus area covers fundamental concepts in microbiology and applies microbiology concepts to natural and engineered aqueous systems with emphasis on water treatment. Career paths related to the Environmental Microbiology focus area include engineering consulting (e.g., municipal wastewater treatment plant design) and process engineering (specialty chemical, food and beverage manufacturing, etc.).

- **CEE 562** Environmental Biochemistry and Waste Treatment
- **CEE 563** Environmental Engineering Chemistry
- **CEE 565** Advanced Environmental Biotechnology
- **CEE 567** Environmental Microbiology
- **CEE 570** Sustainable Environmental Biotechnologies
- **CEE 598** Biotransformations

Environmental Pollutants: The Environmental Pollutants focus area covers fundamental concepts in environmental chemistry and evaluates the fate and transport of chemicals in air, water, and soil. Career paths related to the Environmental Pollutants focus area include engineering consulting (e.g., remediation) and regulatory (e.g., environmental compliance and permitting).

- CEE 560 Soil and Groundwater Remediation
- CEE 563 Environmental Engineering Chemistry
- CEE 564 Contaminant Fate & Transport
- CEE 569 Air Quality Engineering
- CEE 598 Environmental Nanotechnology
- EVE 568 Environmental Risk Assessment

Water Science: The Water Science focus area covers water resources engineering as well as water quality and treatment emphasizing drinking water treatment and water reuse. Career paths related to the Water Science focus area include engineering consulting (e.g., municipal drinking water treatment plant design, water reuse design), natural resource management (e.g., Salt River Project (SRP), Central Arizona Project (CAP), Arizona Department of Water Resources), and municipal (e.g., city water department operations and management).

- CEE 543 Water Resources Systems
- CEE 545 Hydrology
- CEE 561 Physical-Chemical Treatment
- CEE 563 Environmental Engineering Chemistry
- CEE 566 Water Reuse and Reclamation
- EVE 571 Water Quality Modeling

PhD students may organize their coursework to follow one of the focus areas described above.

4. Requirements for PhD Students

4.1. General Requirements

Degree requirements for the PhD include a minimum of 84 credit hours beyond the bachelor's degree and deficiency courses. A maximum of 30 credit hours taken during a master's degree program can be applied to a PhD degree.

The PhD degree program is comprised of five major elements that students are required to pass successfully prior to graduation.

- 1) Filing an approved graduate Interactive Plan of Study (iPOS).
- 2) Completion of approved coursework.
- 3) Pass the Comprehensive Qualifying Exam.
- 4) Approval of the Dissertation Proposal/Prospectus to advance to candidacy.
- 5) Successful oral defense of an approved written dissertation (Doctoral Dissertation Defense).

4.2. Specific Requirements

Eighty-Four (84) credit hours of graduate work beyond the bachelor's degree are required with the following constraints:

- A. Research: Minimum of 12 credit hours of research (CEE 792)
- B. Dissertation: Minimum of 12 credit hours of dissertation (CEE 799)
- C. Coursework: Minimum of 60 credit hours of approved coursework consisting of the following:
 - i. Regular graduate courses taken at the 500 level.
 - ii. One (1) credit of seminar (CEE 591) can be repeated up to three times to count as 3 credit hours of coursework.
 - iii. A recommended limit of 6 credit hours of Reading and Conference (CEE 790) can be taken with an individual faculty member, typically a member of the student's PhD graduate supervisory committee (GSC).
 - a. For a PhD student *with* a previous master's degree, a recommended limit of 18 credit hours of Reading and Conference (CEE 790) can be included on the iPOS, which typically corresponds to the three members of the student's PhD graduate supervisory committee.
 - b. For a PhD student *without* a previous master's degree, a recommended limit of 24 credit hours of Reading and Conference (CEE 790) can be included on the iPOS, which typically corresponds to the three members of the student's PhD graduate supervisory committee and one additional faculty member.
 - iv. Up to 30 credit hours of graduate credit may be allocated from a previously awarded master's degree with approval from the faculty advisor and Graduate College.
 - v. Up to 12 credit hours of pre-admission coursework can be transferred from a previous graduate degree program (where the student did not receive a degree). Transfer of pre-admission coursework requires approval from the faculty advisor and Graduate College.