

## **Environmental and Water Resources Engineering Program**

### **Requirements for Master of Science Degrees in Civil Engineering, Environmental Engineering, and Environmental Sciences and Engineering September 2017**

#### **Program and Degrees**

The Virginia Tech Department of Civil and Environmental Engineering offers the following Master's degree programs in fields related to environmental and water resources engineering:

MS in Civil Engineering (**MS CE**)

MS in Environmental Engineering (**MS ENE**)

MS in Environmental Sciences and Engineering (**MS ESEN**)

The MS CE, MS ENE, and MS ESEN degrees may be earned as coursework-only or, with the permission of the faculty, may incorporate a research thesis or project and report option. Both MS CE and MS ENE degrees are primarily designed for students who have earned undergraduate degrees in Engineering. Students entering the MS CE or MS ENE degree with a non-engineering background must complete several required undergraduate courses, as well as a design experience, as outlined in Appendix A. Note that the requirements for the MS CE and MS ENE are essentially the same. Whether a student should select one or the other depends on personal preference and career goals. The MS ESEN is designed principally for students with undergraduate degrees in one of the physical or life sciences. The objective is to provide students with an exposure to engineering with technical training that is intermediate between the sciences and engineering. Certain undergraduate course may be required upon entering the program (see Appendix A). All students entering any of the MS programs must complete Appendix A – Worksheet for Verification of Core Knowledge Base.

Full details concerning degree requirements as well as admission and registration procedures can be found in the Graduate Catalog at [http://graduateschool.vt.edu/graduate\\_catalog/](http://graduateschool.vt.edu/graduate_catalog/). The complete Graduate Policy and Procedures Manual for the Department of Civil & Environmental Engineering is available at : <https://graduateschool.vt.edu/academics/what-you-need-to-graduate.html>. Commencement deadlines and graduation checklists are online at [http://graduateschool.vt.edu/academics/dates\\_deadlines/commencement\\_deadlines.html](http://graduateschool.vt.edu/academics/dates_deadlines/commencement_deadlines.html).

#### **Admission Requirements**

Admission to either the MS CE or MS ENE degree programs normally presupposes graduation from an accredited undergraduate engineering curriculum. Minimum requirements for admission are an undergraduate grade point average (GPA) of 3.0 or higher for the last 60 credit hours computed on a 4.0 scale. However, admission may be denied to students with higher qualifications, depending on the number of well-qualified applications received in a given year. To be considered for a graduate fellowship or assistantship, students should typically have an overall GPA of 3.5 or better for the last two years of undergraduate work. It is required that all students submit graduate record examination (GRE) scores for the verbal, quantitative, and analytical writing sections. In

some cases, the Graduate School will approve other English tests as proof of language proficiency such as IELTS with a minimum of 6.5.

Admission to the MS ESEN graduate program normally presupposes graduation from an accredited undergraduate curriculum in a related field of science such as Biology, Chemistry, Mathematics, Soil Science, Statistics, or Geology. Students must have a mathematics background that includes three semesters of calculus through elementary differential equations, one semester of statistics, and one year of freshman chemistry and physics with laboratory experiences. If an incoming student does not meet all these prerequisites, then the deficiencies may be taken while in the graduate program. Admission is competitive among applicants, with minimum GPA requirements for undergraduates of 3.3 or higher, computed on a 4.0 scale, for the last 60 credit hours of undergraduate work. Submission of GRE scores for the verbal, quantitative, and analytical writing sections is required. Applicants with GPA between 3.0 and 3.3 will be considered if they have excellent GRE scores.

TOEFL scores of at least 570 (Paper) or 88 (Internet) are expected from international applicants for all degree programs.

Students applying for admission by transfer from another graduate school will be considered on the same basis as those applying initially to Virginia Tech. However, students who are not qualified academically for initial admission to the Graduate School may, if they are able to subsequently demonstrate satisfactory performance for one or more semesters at some other graduate school, be reconsidered. Students accepted by transfer may have up to 50% of the required coursework credit hours transferred, with all other requirements remaining the same. Some restrictions apply to transfer courses. Most importantly, all transfer courses must be approved by the student's Committee and the Program Coordinator or Department Head.

## **Degree Requirements**

Students in all degree programs must complete a required set of core courses. The remaining courses, with some restrictions, are selected by the student to meet their career goals. All candidates must take a minimum of 30 credits to complete degree requirements with the specific requirements depending on the degree option. All students must complete two EWR core courses and a minimum of two additional 5000-level Environmental and Water Resources Engineering courses. In addition, each student must take two credits of Environmental and Water Resources Engineering Seminar (CEE 5944). Note that credits associated with seminar (CEE 5944) do not count towards minimum credit requirements for any degree.

### *Specific Requirements by Degree Option*

Candidates for the MS CE (Thesis), MS ENE (Thesis), and MS ESEN (Thesis) degrees take a minimum of 24 credits of course work, 6 credits of Research and Thesis (CEE 5994), and must complete and successfully defend a thesis.

MS CE (Coursework), MS ENE (Coursework), and MS ESEN (Coursework) candidates must complete 30 hours of coursework and then pass a comprehensive oral exam. Candidates for the

MS CE (Coursework) degree may take 3-6 hours of Project and Report (CEE 5904) with the approval of a faculty advisor. Requirements for the Project and Report include a written report and a presentation to the student's committee. The latter will serve as the comprehensive exam.

All MS degree options have a maximum allowable number of six graded 4000-level credits hours that may be taken. Undergraduate Special Study courses (4984) may be included on a Plan of Study, within the 4000-level as well as the Special Study limitations. Undergraduate Independent Study (4974) may not be used. The remaining coursework credit hours for the thesis option or coursework-only option must be comprised of 5000-level courses. The total number of credits is typically above and beyond the Graduate School minimums of 12 and 15 hours for thesis and coursework-only, respectively. Project and Report counts toward the 30-hour total but not the 15-hour requirement. The maximum Number Independent and Special Study Credits (CEE 5984, 5974, 6984) is 6 and 9 hours for non-thesis (project or coursework only).

### *Core Requirements*

All MS students are required to complete at least two of three core courses in the environmental area or the water resources area. Course options are listed in the summary table of degree requirements on the following page.

### *Other Requirements*

As part of the 24 credit hours of course work, all MS ESEN (Coursework or Thesis), and MS CE and MS ENE candidates without an ABET-accredited engineering undergraduate degree must complete one design course from the list below.

- CEE 4104 Water and Wastewater Treatment Design
- CEE 4274 Land Development Design
- CEE 4334 Hydraulic Structures
- CEE 5125 Environmental Engineering Design I (Wastewater Treatment)
- CEE 5126 Environmental Engineering Design II (Water Treatment)
- CEE 5144 Unit Operations and Process Laboratory
- CEE 5774 Hazardous Waste Management

### *Background Requirements*

All students must complete Appendix A – Worksheet for Verifying Core Knowledge Base which will determine if specific undergraduate courses are also required. Courses at the 3000-level or below do not count towards minimum degree requirements, but some courses at the 4000-level can count towards the minimum degree requirements. Students without an appropriate statistics background from their undergraduate degree must take an approved statistics course during the graduate program (CEE 5724 Environmental Sampling and Monitoring or another statistic course are acceptable for this purpose). **Supporting courses on the plan of study do not count toward minimum degree requirements.** Required background courses should be listed under the supporting course section of the plan. If the required background course is 1000 or 2000 level, it may be taken in the P/F or normal (A-F) grade modes. If the required background courses are

3000 or 4000 level, they MUST be taken in the normal (A-F) grading mode.

**Summary of Degree Requirements for the Master's Degree Program  
Environmental and Water Resources Engineering**

Requirement	Degree			
	MS CE Thesis	MS CE Non-Thesis	MS ENE MS ESEN Non-Thesis	MS ENE MS ESEN Thesis
Foundation Coursework	6 Credits: Either complete requirements for Environmental Core Courses (Group A) or requirements for Water Resources Core Subjects (Group B)			
Minimum 5000-level EWR Coursework Credits <sup>1,2</sup>	12	15	15	12
Maximum 4000-level Coursework Credits	6	6	6	6
Thesis Credits	6	0	0	6
Optional Project and Report Credits (CEE 5904)	N/A	3-6	3-6	N/A
Maximum Independent and Special Study Credits (CEE 5984, 5974, 6984)	6	9	9	6
Minimum Credits for Degree	30	30	30	30
EWR Seminar (Credits do not count towards degree)	Complete two semesters			
Design Coursework	Minimum of one course from list of approved design courses. Only required for students without an ABET-accredited undergraduate degree in engineering.			
Verification of Core Knowledge Base (Appendix A)	Required			
Statistics Proficiency (At least one undergraduate or graduate course in Statistics; CEE 5724 can be used)	Required			
<sup>1</sup> Note that the minimum required EWR coursework hours does not fulfill Graduate School minimums at the 5000 level.				
<sup>2</sup> Foundation Coursework counts toward the 12-15 hour requirement.				

(A) Environmental Core Courses – Complete two courses from:

CEE 5104 – Environmental Chemistry	CEE 5304 – Environmental Fluid Mechanics	CEE 5794 – Environmental Engineering Principles
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(B) Water Resources Core Subjects – Complete one course from each of two core subject areas:

Hydrology/EFM	Groundwater	Surface Water Hydraulics
CEE 5324 – Advanced Hydrology	CEE 5374 – Dynamics of Groundwater	CEE 5314 – River Mechanics
CEE 5734 – Urban Hydrology	CEE 5344 – Surface-Groundwater Interaction	CEE 5344 – Surface-Groundwater Interaction
CEE 5304 – Environmental Fluid Mechanics	CEE 5354 – Numerical Modeling of Groundwater	CEE 5384 – Advanced Open Channel Flow
CEE 5244 – Advanced GIS in Hydrologic Analysis		CEE 5854G – Coastal Engineering
CEE 5334 – Quantitative Hydrology		

## Credit Hour Loads

A full-time graduate course load is considered to be 9 to 18 semester credit hours. Students on fellowship, scholarship, or graduate assistantship, including teaching and research assistantships, must take a minimum of 12 credit hours per semester. Unfunded students must take a minimum of 9 credit hours per semester. Audited courses are not counted toward the minimum requirements for enrollment (but do not count toward maximum credit load).

## Graduate Student Advisory Committee and Program of Study

Students working on an MS thesis degree in CE, ENE, or ESEN must work with their Major Advisor to assemble a Graduate Advisory Committee as early as their first semester in the Program, but no later than the middle of the second semester. The committee shall consist of at least three faculty members, two of whom must be from Environmental and Water Resources Engineering. An Advisory Committee is also required for MS (Coursework) degrees in CE, ENE, and ESEN. This committee is selected by the student and Major Advisor for coursework students completing a Project and Report. The advisor and committee may be assigned by the department for other coursework students.

MS CE (Thesis), MS ENE (Thesis), and MS ESEN (Thesis) candidates should communicate with their committee about courses they should take and their research. A brief description (1-2 pages) outlining objectives and research approach should be provided to committee members either before or shortly after the research is initiated. Members of the Graduate Advisory Committee will evaluate each student's progress at committee meetings (at least once per academic year) and be available for consultation with the student. The committee members should be apprised of research progress regularly and, at least six months prior to the thesis defense, the student must assemble the committee for a formal discussion of progress and work planned to complete the project. The thesis should first be approved by the student's advisor and then submitted to the advisory committee at least two weeks prior to the defense of the thesis.

All students shall formulate a Plan of Study in consultation with their Major Advisor. **All students must submit an approved Plan of Study before the completion of 15 credit hours of coursework.** It is recommended that students submit an approved Plan of Study before the start of their second semester. A Program of Study form is available on the EWR web page (<http://www.cce.vt.edu/graduate-information-and-forms>.) The student must obtain approval signatures and then return the approved Plan of Study to the Program's main office. The form is then submitted to the CEE Graduate Student Coordinator in the Student Advising Center in Patton Hall.

All MS candidates, regardless of degree option, must have the Plan of Study approved by their Advisory Committee. Any subsequent changes to the Plan of Study require that appropriate documentation be filed with the Graduate School. All Advisory Committee members must approve such changes.

The Graduate School requires that the progress of each graduate student be evaluated by the

Advisory Committee at least once a year, and that a report be placed in the student's file. In addition, **the CEE Department now requires all graduate students to submit a written annual progress report.** Immediately following the Spring semester, each student will electronically submit a one-page report (instructions are emailed to the graduate student listserv each year) to their advisor/committee that summarizes coursework, research activities (if applicable), achievements, and plans for future progress over the past 12 months or from their date of admission if in their first year. In the academic year in which a student completes all degree requirements before the end of the Spring semester, no report is required.

### **MS CE, ENE, and ESEN Coursework-Only Final Exam Preparation Instructions**

1. The final exam will be oral, and will typically require no more than one hour to complete.
2. The exam will start with a short 10-minute PowerPoint presentation giving an overview of your career trajectory (where you have come from and where you are going) and summarizing your progress through the graduate program including a listing of the sequence of graduate courses taken (where and when you took them and the name of the instructor). A PC-based laptop (with USB port) and computer projector will be available.
3. During and after the presentation, the faculty members (probably three) conducting the exam will ask questions.
4. The questions will probe your understanding of the material covered in the courses you completed during your program as shown on your Plan of Study. Questions will test your understanding of concepts and principles and not your ability to solve detailed quantitative problems. For example, a student with CEE 5125 or CEE 4104 on their plan of study could be asked to
  - a. diagram a typical municipal wastewater treatment process, or
  - b. describe the objective of the biological reactor and how that objective is achieved, or
  - c. explain the Monod relationship.
5. In general, while you would not be asked to calculate the settling velocity in water of a particle with a specific gravity of 1.05 and an effective diameter of 0.1 mm, you could be asked to describe how you would go about estimating the settling velocity of a particle in a fluid, and what factors will influence the settling velocity.
6. The exam will be closed book, closed notes.

If a student fails the examination, one full semester (a minimum of 15 weeks) must elapse before the second examination is scheduled. No more than two opportunities to pass the examination are allowed. A student failing the examination twice will not be allowed to continue in the program.

Note that Coursework students who complete a Project and Report use the final presentation of the work to their committee in lieu of a final examination.

### **Steps to the Master's Degree**

**Note:** It is the student's responsibility to ensure timely completion of each one of these steps. Graduate School forms and deadlines can be found at [www.graduateschool.vt.edu](http://www.graduateschool.vt.edu). It is the student's responsibility to complete and submit all forms and understand the deadlines.

### Thesis Option

- (1) Selection of Major Advisor and Research Topic.
- (2) Selection of Graduate Advisory Committee.
- (3) Development of Plan of Study (prior to completion of 15 credit hours).
- (4) Meeting of Graduate Advisory Committee to discuss research goals and progress.
- (5) Registration in the semester of final defense: You may use a regular registration OR a special registration (a.k.a. Start of Semester Defense Exception-SSDE).
- (6) At the beginning of the final semester, the form "Application for Degree" must be completed through Hokie SPA.
- (7) Final Defense of Thesis. The electronic form "Request to Admit Candidate to Final Exam" must be submitted to the Graduate School **at least two weeks before the date requested:** <https://ess.graduateschool.vt.edu/pages/login.php>. The Graduate School will notify the student, committee, and departmental representatives when the electronic exam card has been released.
- (8) Students have two weeks following the final exam to submit their thesis (ETD) to the Graduate School through the online exam system. It is the responsibility of the student to confirm that all committee members filed their online approval of the ETD, so their degree may be awarded.

### Project & Report (non-thesis) Option

- (1) Selection of Major Advisor and Project Topic.
- (2) Selection of Graduate Advisory Committee.
- (3) Development of Plan of Study (prior to completion of 15 credit hours).
- (4) Meetings (as needed) of Graduate Advisory Committee to discuss research goals and progress of research efforts.
- (5) Registration in the semester of final defense: You may use a regular registration OR a special registration (a.k.a. Start of Semester Defense Exception-SSDE).
- (6) At the beginning of the final semester, the form "Application for Degree" must be completed through Hokie SPA.

(7) Final Defense Project and Report. The electronic form “Request to Admit Candidate to Final Exam” must be submitted to the Graduate School **at least two weeks before the date requested:** <https://ess.graduateschool.vt.edu/pages/login.php>. The Graduate School will notify the student, committee, and departmental representatives when the electronic exam card has been released.

#### Coursework only-Non-Thesis Option

- (1) Selection of Major Advisor and Graduate Advisory Committee.
- (2) Development of Plan of Study (prior to completion of 15 credit hours).
- (3) Completion of program area Writing/Independent Study Effort (if required).
- (4) Registration in the semester of final defense: You may use a regular registration OR a special registration (a.k.a. Start of Semester Defense Exception-SSDE).
- (5) At the beginning of the final semester, the form “Application for Degree” must be completed through Hokie SPA.
- (6) Final Examination. The electronic form “Request to Admit Candidate to Final Exam” must be submitted to the Graduate School **at least two weeks before the date requested:** <https://ess.graduateschool.vt.edu/pages/login.php>. The Graduate School will notify the student, committee, and departmental representatives when the electronic exam card has been released.

## Appendix A

### Worksheet for Verifying Core Knowledge Base

Students must have a well-developed “core “knowledge base for successful graduate study in EWR. Departmental policy requires that each student document having met this requirement.

*Instructions*

Please complete this worksheet in consultation with your advisor (or temporary advisor) who will then work with you to plan the first semester’s courses. This process may involve reviewing transcripts from your former institution(s). Your advisor (or temporary advisor) will make a preliminary assessment of your core knowledge base, initial the worksheet on the second page and make an electronic copy (pdf) as a record. Your advisory committee will also review the worksheet, typically during the second semester. The advisory committee will either approve the worksheet (usual case) or ask you to take additional courses (unusual case).

Student Name (Last, first)	
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**1. Students with an ABET-accredited Engineering degree**

Graduates of ABET-accredited engineering programs are assumed to have the required core knowledge base\*. If you are in this group, place a check in the box on the following line and write in the institution and year of your undergraduate engineering degree.

Graduate of ABET accredited engineering program	✓	Institution	Year
	<input type="checkbox"/>		

**2. Students without an ABET-accredited Engineering degree enrolled in a graduate engineering degree (MS CE, MS ENE, PhD CE)**

Students must complete the courses below or demonstrate having taken an equivalent course at another institution. Students should enter the course number, name and grade earned in each course or equivalent course. Missing courses/equivalent courses can be taken either before or after entering the graduate program. Courses at the 1000/2000 level can be taken pass-fail (P/F). Courses at the 3000/4000 level must be taken for a letter grade (A/F). These undergraduate background courses do not count toward graduate degree requirements.

Required VT Course	✓	Course/Equivalent Course	Grade (or P/F)
Chemistry 1035 – <i>General Chemistry</i>	<input type="checkbox"/>		
Math 1205 – <i>Calculus</i>	<input type="checkbox"/>		
Math 1206 – <i>Calculus</i>	<input type="checkbox"/>		
Math 2214 – <i>Differential Equations</i>	<input type="checkbox"/>		
Math 2224 – <i>Multivariable Calculus</i>	<input type="checkbox"/>		
Physics 2305 – <i>Physics I</i>	<input type="checkbox"/>		

