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1 INTRODUCTION

The purpose of this handbook is to provide information to graduate students and potential graduate students about the Graduate Programs within the Graduate Program of Civil and Environmental Engineering (CEE) at the University of Vermont (UVM). These Programs are under the auspices of the Graduate College which is responsible for all advanced degrees at the University of Vermont and sets forth the minimum requirements and standards. These requirements are available on their website (click here)\(^1\) which provides excellent information about the Graduate College policies, procedures, deadlines, and courses and should be consulted by interested graduate students. This handbook provides additional details that are specific to the Civil and Environmental Engineering Graduate Programs. All graduate students are expected to become familiar with this handbook and other graduate college information within the first months of attending UVM.

2 THE PROGRAMS

The Civil and Environmental Engineering Programs (click here)\(^2\) are part of the School of Engineering in the College of Engineering and Mathematical Sciences (click here)\(^3\) at the University of Vermont (click here)\(^4\).

The Programs offer B.S., M.S. and Ph.D. degrees.

Students pursuing an M.S. or Ph.D. degree in CEE may seek advanced training and research in a variety of areas in Civil Engineering including Geotechnical, Structural, Transportation, Hydraulics, Materials, and in Environmental Engineering.

2.1 Research

Research is an integral part of the graduate student experience within our Graduate Programs and all students are expected to develop capabilities for independent research during their tenure at UVM. It is, therefore, very important that students be interested and enthusiastic about their research topic. All graduate students are expected to make a contribution to the scientific or engineering field related to their area. Information regarding research topics can be found on our website (click here)\(^5\) Student involvement in specific research areas may be limited based upon the available openings identified with each of the faculty members. Upon acceptance into the program, it is often advisable for students to contact the Graduate Program Coordinator or specific faculty members to discuss research options available to them.

2.2 Facilities

Program laboratories include the Environmental Fluids Laboratory, the Soils Laboratory, the Structures Laboratory the Concrete/Materials Laboratory, the Atmospheric Emissions and Air Pollution Laboratory, the Physical Groundwater Flow and Transport Modeling Facility and the Transportation Systems Research Laboratory. These are located on the first floor of the Votey building. Environmental Engineering Chemistry Laboratories are located on the first and second floors of Votey. Students should be aware of important safety

\(^1\)www.uvm.edu/~gradcoll/
\(^2\)http://www.uvm.edu/~cems/soe/
\(^3\)www.cems.uvm.edu
\(^4\)www.uvm.edu
\(^5\)www.uvm.edu/~cems/soe/?Page=grad/cee/default.php&SM=grad/gradmenu.html
rules (see Section 2.2.9) associated with these laboratories and should be aware of research and classes that may be underway at certain times.

2.2.1 Environmental Fluids Laboratory

This laboratory includes a state-of-the-art groundwater physical model (10' by 14' by 8') that contains a dense matrix of sophisticated sensors (temperature, pressure, moisture content, conductivity and water sampling probes), a data acquisition system and pumping capability from 84 locations in the physical model. This laboratory also houses a large 40' flume, recirculating water supply, a Pelton wheel, friction factor/pressure drop piping arrangement, a small moveable flume, and many full-sizes valves and orifices within pipe networks.

2.2.2 GIS Laboratory

The Programs maintain a GIS laboratory that has NT-based computers with ESRI-Arc/Info software and a large-format color plotter. In addition, this laboratory contains various equipment used for field work at streams and wetlands such as; flow meters, water level meters, total stations, GPS units, laser levels, pressure transducers, barometric pressure loggers, tensiometers, water quality probes, and rain/snow gauges.

2.2.3 Surveying Laboratory

Instruments available include automatic levels, digital transits, theodolites, EDM, total stations, portable GPS receivers, and one GPS base station.

2.2.4 Soils Laboratory

The Soils Laboratory houses several computers, the data acquisition system, and a high performance liquid chromatograph that are necessary for the groundwater physical model. The soils laboratory is equipped to conduct many of the standard suites of tests associated with basic instruction and research in Geotechnical Engineering. Testing capabilities include grain size analysis, permeability determination, compaction determination (including Harvard miniature), CBR testing, consolidation testing, direct shear testing and triaxial tests.

2.2.5 Structures Laboratory

The laboratory has two universal testing machines, a 300,000 pound Young static machine for compression and tension measurements, a 200,000 pound static machine with a 10' long specimen for compression. In addition, this laboratory contains four loading frames, a 60,000 pound Tnius-Olsen machine for compression and tension testing, and a 10,000 MTS system for force or displacement controlled testing in tension or compression, and a special testing floor. The universal machines are maintained and calibrated on a regular basis. These machines have full-scale capacities ranging from 600 pounds to 300,000 pounds. The beam/column machine has an electronic load cell adapted, rather than utilizing the older, mechanical load measuring system.

2.2.6 Concrete/Materials Laboratory

This laboratory is equipped for materials testing that involves concrete mixes, additives and curing histories. The curing environment is a mobile curing box. Equipment for measuring, mixing, and testing are in good
condition, and are able to handle casting of cubes, cylinders, or beams. This laboratory contains sieves and a shaker for media analysis, large drying ovens, balances and other standard equipment.

### 2.2.7 Transportation Research Center

Vermont’s Transportation Research Center (TRC) is a hub for innovative and interdisciplinary research, education and outreach on sustainable transportation system solutions. The TRC focuses on transportation planning as it relates to resilience, energy and health.

The Transportation Research Center is a multidisciplinary matrix research center involved in project based research and academic pursuits. We have access to a diverse in house staff including experienced business and project manager, research staff, outreach staff, faculty, and graduate research assistants. We also utilize a strong network of partners including various schools at UVM, local, state, and federal agencies, non-profits, and private sector partnerships.

The Transportation Research Center partners across campus with active labs and programs:
- Transportation Air Quality Lab (TAQLab)
- UVM Spatial Analysis Lab
- UVM Park Studies Lab

Nationally the Center engages in a diverse set of research and outreach activities
- It is a member of the team that comprises the National Center for Sustainable Transportation at UC-Davis
- It is one of five regional Transportation Workforce Centers funded by FHWA in 2014.

### 2.2.8 Hazardous Waste Research Laboratory

This facility is located on the second floor of Votey and contains a variety of soil column systems, micromodels, and two-dimensional models for investigating contaminant transport and behavior in porous media. This laboratory also contains a Hewlett-Packard gas chromatograph with three detectors, two automated samplers and HP chemstation software for analysis. In addition, there is a goniometer to measure interfacial tension and contact angle, a fume hood, balances, centrifuge, microscopes, ovens, controlled temperature rooms, shakers, and other laboratory equipment.

### 2.2.9 Environmental Engineering Teaching Laboratory

This laboratory contains various bench-scale experimental systems for education and research experiments. In addition it contains a surface area analyzer, portable gas chromatograph, microbalance, fume hoods, refrigerators, pH meters, visible spectrophotometers, conductivity meters, a centrifuge, an autoclave, water purification systems, microscopes and other standard laboratory equipment.

Students or personnel working in the preceding two laboratories should be familiar with important rules related to these labs. The first and foremost is safety.

**Laboratory Safety** Courses taught and research performed in these laboratories often involves the use of potentially toxic and hazardous chemicals and disease-causing organisms. In the interest of protecting all students and laboratory personnel, it is important that each individual exercise common sense, good judgment and safe laboratory practices. The following is a list of information pertaining to laboratory safety and rules that must be followed when working in the laboratory.
1. Attend a class offered by the Environmental Safety Facility (ESF) personnel. This is a **mandatory requirement** for graduate students working in the laboratories.

2. Know the location of the following emergency items in each laboratory; Emergency shower, Fire extinguisher, First aid kit, Emergency spill kit.

3. Emergency phone number: dial 911.

4. Make sure you are well prepared for laboratory exercises and understand the nature of the chemicals and biological materials you are working with. If you are unsure of something, ask a responsible faculty member. You should assume a chemical is hazardous unless instructed otherwise. Pay attention in the laboratory.

5. No smoking, eating or drinking in the laboratory. Always wash hands before touching eyes, nose or mouth and prior to leaving the laboratory for the day.

6. **NEVER** add chemicals back into the stock reagent bottle after you have withdrawn the chemical. **NEVER** pipette liquids from the original storage bottle. Transfer the liquid to a beaker. Pipette the liquid from the beaker. Know the specific disposal procedures for your chemicals.

7. In the case of spills, notify the instructor or responsible faculty member immediately. Do not use bare hands to clean up mercury, acids, bases, solvents or other materials of unknown toxicity.

8. Broken glass should be disposed of in the box near the door.

9. Dispose of excess chemicals as advised by ESF or a responsible faculty member. **NEVER** put chemicals back into the original bottle.

*Federal Chemical Right-to-Know Law* requires the availability of Material Safety Data Sheets (MSDS) for employees, and training of employees in chemical usage.

**Additional Laboratory Information**

1. You are responsible for cleaning all glassware and your workstation at the end of your laboratory sessions. Do not leave dirty dishes by the sink for any prolonged period of time, especially when classes are in session. Unless otherwise directed, first wash with detergent and thoroughly rinse with tap water.

2. If you break anything in the laboratory, please report it to a responsible faculty member so that they are aware of it and can order replacements as needed. Some items may need to be replaced by the student’s advisor from research grants.

3. Never take items or touch other people’s experiments without first consulting with them.
2.2.10 Field sites

A constructed wetland center is located at the campus dairy farm. This fully functioning wetland with multiple cells and smaller research cells will be used for research, education and demonstrations. The system is instrumented with spatially distributed, nested piezometers for evaluating continuous flow through the wetland and flow and water quality monitoring devices. It will be used to determine the flow and contaminant fate and transport through the system.

A natural ombrotrophic bog is currently monitored to understand bog hydrology and its impact on biodiversity. The bog is instrumented with a weather station and a unique factorial design of nested piezometers allowing examination of the three-dimensional flux of water and various geochemical parameters in bog pore-water.

Numerous streams and their watersheds are used for research, as well as Lake Champlain. Various UVM engineers (CEE) and scientists from other departments are involved in a number of Lake Champlain research projects.

2.2.11 Libraries

There are three libraries located on the UVM campus, Bailey/Howe Library, Cook Physical Sciences Library, and the Dana Medical Library. The Bailey/Howe Library is the main library on campus that includes the majority of books and periodicals. It is also home to Government Documents, Reserve Section for various classes, Media Services, Reference Section, Special Collections, Study rooms, and additional computers for student use. The Cook Library and the Dana Medical Library include collections in the physical, medical and health-related sciences.

All UVM libraries have on-line computer systems (click here)\(^6\), which includes UVM holdings as well as access to a variety of reference databases. Students should become familiar with the on-line system. Reference Librarians can assist students in how to use the different data bases available. Inter-library loan is used for obtaining books and articles that are not available within the library.

2.2.12 Computer Support

The College of Engineering and Mathematical Sciences (CEMS) computing facility is located on the second floor of Votey. Personnel in this unit maintain the computer laboratories within Votey, set up computer and e-mail accounts for students, and deal with a variety of hardware concerns for faculty and laboratory computers. They can be reached by e-mailing “help@cems.uvm.edu”.

They generally do not provide technical support for specific software applications. This is achieved either by talking to other students and faculty or by contacting the software company sales and technical representatives. Beyond setting up student accounts, the computer facility services are available on a fee basis and therefore need a budget number before the facility can start a job.

The Programs and individual faculty members maintain computers within Program offices and laboratories. The ones in laboratories or graduate offices are often shared. Computers within the College computer laboratories are also available for student use. Students should also have access to their own computers for home use. Laptops are useful in that they can be used at work or in the field. Laptops left in offices at night should be locked in drawers or cabinets to protect them from theft.

\(^6\)http://library.uvm.edu
Microcomputer Services on campus has computers from a variety of manufacturers available for sale to students. They generally sell at competitive prices and assist in the initial set up and installation of the computer.

2.2.13  Metal Machine Shop

The College also maintains a complete metal machine shop with a computerized milling machine, high speed lathes, drill presses and other standard shop equipment. This facility is available for some student use, provided the students have sufficient training, including safety training, in the shop. The shop manager can provide assistance in designing and building needed items and in training. A wood shop in Williams Hall is available upon approval by the shop manager.

2.2.14  Other Facilities of Interest

The Risk Management Department provides the campus community, including staff, faculty, students and visitors, with the support, advice and leadership necessary to maintain a safe, healthy campus; to minimize liabilities; and to protect the University’s assets. This is done through a comprehensive risk identification process and by providing effective risk financing, sound claims management, health and safety support services, and regulatory compliance assistance.

The Environmental Safety Facility (click here)\(^7\) provides information such as safety training, and laboratory hazardous waste management that will be useful for graduate students working in chemical laboratories in the Votey building. Some chemicals can also be purchased through the ESF. All graduate students working in one of the environmental engineering chemical laboratories must complete a safety training course at the ESF. These should be scheduled prior to working in the laboratories.

The Chemistry Department in the Cook Building operates a glass blowing facility which can be used for making specialty glass items or for repairing laboratory glassware.

3  GRADUATE PROGRAMS

The Civil and Environmental Engineering Programs offer graduate study leading to the degrees of Masters of Science and Doctor of Philosophy. A Summary Record Form is found in the Appendix and will be used by the student and advisor to keep a record of the completion of various requirements as they are fulfilled.

3.1  Acceptance into the Program

Applications to our programs must be received by the Graduate College by February 1 of each year for the following fall, and the Program faculty generally begins to review these in March. Early admissions may be made for extra-ordinarily strong applicants. Although admission in January is possible, applying by February 1 for entrance in September provides the student with the best chance for funding opportunities.

The applications are reviewed by the entire faculty in terms of grade point average, graduate record examination (GRE) scores, letters of recommendation, statement of interest, then TOEFL scores (international students) are also considered. Strengths in some areas can make up for deficiencies in others. The Programs seek to find high quality, motivated students whose interests and strengths best match the strengths of the Programs.

\(^7\)http://esf.uvm.edu
The first step in the review process is to determine who is qualified. This is based on the application package. Therefore, it is important that the package is complete and reflect the applicant’s strengths and interests. Of the qualified applicants, we then determine who in the faculty would be the applicant’s advisor. Only applicants with at least one faculty member committed to be their advisor are admitted. This ensures that all of our graduate students have the commitment of a faculty member during their tenure as a graduate student. In the cases where several faculty members may be interested in advising a student, we often decide later with input from the applicant who will be the advisor.

Qualified applicants who have the commitment of at least one faculty member are admitted. Given the admitted students, awarding of the graduate teaching assistantships and research assistantships is then determined based on applicant qualifications and the need for the applicant’s skills within the Programs.

3.2 Basic Requirements for Admission

All applicants must have an undergraduate degree from a recognized University. A Bachelor of Science degree in engineering is preferred, but applicants with a B.S. degree in one of the sciences are often accepted. The latter, however, must have a minimum of the following course work: three semesters of calculus; one semester of differential equations; one semester of physics; and one semester of chemistry. Some of these courses may be in progress preceding the desired Fall of admission but this should be indicated in the application package. Additional course work at the undergraduate level is normally required for those who lack a sufficiently strong civil or environmental engineering background, and this course work may not count as credit for the graduate degree.

A grade point average of at least a 3.0 is expected but as previously stated, the entire application is considered, and in some cases, applicants with lower GPAs may be admitted. GRE scores are another indication of the potential of the applicant for success in the program.

Three letters of recommendation are thoroughly reviewed by the faculty for indications of the applicant’s potential for success in our graduate programs. The applicant’s own statement of interest is very important for determining their fit into the programs. It is therefore important that the applicant understand the research and educational opportunities available within our Programs to determine if that is where their interests lie.

International students must have Test of English as a Foreign Language (TOEFL) scores of at least 80 (computer-based) for admission, and 100 for teaching assistantships.

3.3 Maintenance of Good Standing

In addition to the requirements set forth by the University and Graduate College, our students must maintain a cumulative GPA of 3.0 to remain in our graduate programs. In addition, all students must faithfully and responsibly fulfill their duties associated with their assistantships. They must also show adequate progress toward fulfilling their graduate degree requirements and regularly attend the graduate seminars.

Students that have been accepted contingent upon completion of certain undergraduate course work must fulfill those requirements within the first two semesters of the program (scheduling permitting).

A written proposal and oral proposal defense presented to the appropriate graduate committee members (Section 3.5) must be successfully completed by the end of the first calendar year for M.S. students and the end of the second calendar year for Ph.D. students.
3.4 Full-time Status

A minimum of six credit hours is required during the academic year to maintain full-time graduate status. No credit hours are required during the summer to maintain graduate status. Students that have completed their course requirements, but have not completed all graduation requirements, may enroll each semester for Continuous Registration (GRAD 901-903) continuous registration fee. Most full-time graduate students take 6-10 credits per semester (see Section 8.1 for more details).

3.5 Faculty Advisor and Committees

A faculty advisor is selected prior to enrollment or during the first semester in the program. Beyond the first semester, financial and time commitments by the advisor justify that any change of advisor be approved by the Graduate Program Coordinator.

By the end of the first year for M.S. students, the advisor (with the student’s input) will recommend a Studies Committee to the Graduate Program Coordinator. This committee will consist of the advisor, at least one additional member of the Program graduate faculty, and at least one member of the graduate faculty outside of the Programs. Additional members outside the graduate faculty are also allowed. The committee’s responsibility is to provide advice regarding the student’s program of study and research activities. This committee will also participate in the review of the proposal and thesis.

By the end of the second year for Ph.D. students, the advisor (with the student’s input) will recommend two committees to the Graduate Program Coordinator; a Comprehensive Examination Committee, and a Studies Committee. The Comprehensive Examination Committee will consist of at least five faculty members who are responsible for the student’s comprehensive examination. The Studies Committee will consist of at least four graduate faculty members; the advisor, at least one member of the Programs’ graduate faculty and at least one member of the graduate faculty from outside the Programs that will review and comment on the required course work, research proposal and on the dissertation defense.

3.6 Proposal Requirements

All graduate students are required to prepare a written research proposal and to present this to their Studies Committees. The proposal will be presented by the end of the first calendar year for full-time M.S. students, and the end of the second calendar year for full-time Ph.D. students unless a time extension is approved by their committee and the Graduate Program Coordinator.

The written proposal must include the following: introduction to the topic, specific research goals and objectives, and/or hypotheses, pertinent background and literature review, methodology with sufficient detail, expected results, time line and literature cited. This should be given to the committee members at least one week prior to the oral presentation. All committee members must attend the oral presentation of the proposal. The format for this oral presentation is left to the discretion of the advisor. If the committee does not feel that the proposal is adequate, they may allow the student an additional two-month time period to make appropriate modifications. Successful completion of this requirement should be reported to the Graduate Program Coordinator using the appropriate form in the Appendix.

3.7 Research Expectations

Students doing a M.S. thesis or Ph.D. dissertation are encouraged to work toward producing publishable research results. The research should be original and the students must demonstrate the capability for
independent research. In general, M.S. thesis option students generate one publishable research paper from their research, and Ph.D. students generate at least two research papers from their doctoral research.

The recommended format for the thesis and dissertation is the Journal Article Format, in which the various research chapters are written as articles publishable in a scholarly journal. Many faculty advisors only accept this format for their students. Generally, the student and advisor select an appropriate journal for expected publication and use that journal requirements as a guide. An Abstract, Introduction, Background and Conclusion Section are also required for the thesis or dissertation and are in addition to the journal article. Specific guidelines on the thesis and dissertation format can be obtained from the Graduate College. Guidelines for writing the articles can be obtained from the student’s advisor and committees.

3.8 Professional and Career Enhancement

Students go to graduate school for a variety of personal and professional reasons, and it is important for students to articulate their goals early in the program so that they can get the most out of their graduate school experiences. We recommend that students discuss their goals and career opportunities regularly with their advisors, committees, other faculty members and other students so that they can develop a clear vision of where they would like to be and what they would like to do when they graduate from the program.

Students should also take advantage of various opportunities for career development existing within the Programs, Graduate College, Center for Teaching and Learning, Training and Development and other groups on campus. Considerable information is available on the web or by inquiring at the Graduate College. Students should take an active role in their own professional and career development.

4 PROGRAM REQUIREMENTS

4.1 Masters Degree Requirements

Students accepted into the M.S. program select either a thesis or non-thesis option within the first semester of enrollment. Generally, only thesis option students are funded. The overall requirements for each option are presented in Table 1.

Table 1. Comparison of requirements for the thesis and non-thesis options.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Thesis Option</th>
<th>Non-thesis Option</th>
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<tbody>
<tr>
<td>Total Minimum Credits</td>
<td>30*</td>
<td>30</td>
</tr>
<tr>
<td>Research Credits</td>
<td>6-9</td>
<td>3</td>
</tr>
<tr>
<td>Comprehensive Examination</td>
<td>Oral Examination</td>
<td>Written Examination</td>
</tr>
<tr>
<td>Research Document</td>
<td>Thesis</td>
<td>Report</td>
</tr>
</tbody>
</table>

* includes research credits

4.1.1 Course work

Specific course work for the M.S. degree is to be decided by the student and the Studies Committee, however, the following guidelines generally apply:
1. Six credits of statistics at the graduate level;

2. Twelve to fifteen credits of engineering course work at the graduate level;

3. Three to six credits of course work outside the Programs.

The course work should be laid out to enhance the student’s research experience, and to meet the interests and professional needs of the student. A maximum of one course at the 100 level is allowed subject to the approval of the Studies Committee before taking the course. The Graduate College must also be informed prior to taking the course. Under no circumstances is course work at less than the 100 level allowed for graduate credit. Course work at the undergraduate level required by students to make up deficiencies at the undergraduate level may not be allowed as graduate credit.

A research project (taken as a CE 295 special topics course) is required for the non-thesis option students. The approach and the topic will be developed by the student and advisor with input from the Studies Committee. This is usually a semester-long project resulting in a final report.

4.1.2 Comprehensive Examination

A comprehensive examination is required of all M.S. students and must be completed before the thesis defense. For thesis option students this generally takes the form of an informal oral examination with the Studies Committee and often focuses around the basic principles behind the thesis research. This should generally take place in the semester preceding the thesis defense.

For non-thesis option students, the required format is a written examination consisting of four topics related to the student’s course of study. The advisor solicits written questions from instructors from the courses the student has taken. This is usually taken in the last semester of their program.

The comprehensive examination is graded satisfactory (S) or unsatisfactory (U). If unsatisfactory, the student retake the examination with the advisor’s permission.

Doctoral students who pass the Doctoral comprehensive examination at a level commensurate with expectations applicable to Master’s level comprehension of the examination materials we be determine to have satisfied the Master’s level comprehensive examination and, given the course credit requirements for the Master’s degree have been satisfied, the student may apply for the non-thesis Master’s degree.

4.1.3 Time Limits and Residency

The maximum time for completion of the M.S. is three years for full-time students and five years for part-time students. Leave of absences, withdrawal from the program and continuous registration are all defined by the Graduate College and are strictly adhered to by our Programs.

Master’s degree students must satisfactorily complete 21 credit hours in residence, 15 of which must be graded credits. This requirement is met by taking courses for graduate credit at UVM, as long as those credits are taken after a student has been admitted by the Graduate College to the program in Civil and Environmental Engineering.

4.1.4 Thesis Research

The thesis research generally takes one to one and a half years to complete (generally working part time during the academic year and full time during the summer), and an additional three to six months for documenting the results in a thesis. M.S. students should determine their thesis topic by their second
semester and begin a literature review during that semester. The _average_ time to complete the M.S. is two years. This includes two summers actively involved in the research. Students should sign up for CE 391 _Master’s Thesis Research_ for research credit.

Students are required by the Graduate College to use a certain format for the thesis in terms of margins, fonts, and other details. The guidelines are laid out in “Guidelines for Writing a Thesis or Dissertation” and are available from the Graduate College. Students should also obtain a copy of the “Thesis/Dissertation Format-Defense Checklist” ([click here](#))

The Graduate College presents a yearly calendar outlining deadlines for thesis defenses, for submission of the thesis and also provides the appropriate forms required to graduate by a certain time. This updated calendar can be found on the Graduate College Web site.

### 4.1.5 Thesis Defense

Students must also submit a notice to the Graduate College informing them of the date and title of the thesis, one month prior to the defense date. A format check with the Graduate College staff should be scheduled three weeks prior to the defense.

The Studies Committee will act as the thesis defense examination committee. The chair of the committee will be the graduate faculty member who is outside the student’s Program. The members of the Studies Committee must receive a copy of the thesis at least two weeks prior to the defense date. The format for the defense is as follows:

1. Student gives a formal seminar on their thesis research. This should take between **40 and 45 minutes**. Graduate students, other faculty, friends and interested people may attend. The talk should include an introduction, goals and objectives, methods, results and discussion, and conclusions. The general audience is not allowed to interrupt the speaker with questions during the defense.

2. After the presentation, the general audience may ask questions of the speaker for a maximum of approximately 15 minutes.

3. The audience leaves and the committee remains. Any member of the graduate faculty may remain also. The committee may then ask additional questions related to the research or related underlying principles. This usually takes about an hour, sometimes a little longer.

4. The student is then asked to leave the room and the committee discusses the thesis and its defense. The committee generally wants some changes, or additions, usually to the discussion and analysis sections. Once they have decided on the necessary changes, the student comes back into the room. If the changes are relatively minor, the student passes with the requirement of making the necessary changes and having those checked by the advisor. If major changes or additional work is required, then the student would be allowed additional time to complete the work and re-defend providing they are still within the required time-limit.

5. The necessary forms must be submitted to the graduate college

The acceptability of the thesis is determined by the thesis defense committee. A grade of S or U is awarded. The student is allowed one re-examination if the examination performance was not satisfactory. After the defense, there may be numerous revisions required and the student should be aware of this possibility. After

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corrections have been made and the signature page has been signed the student must submit the original
and two copies of the corrected thesis to the Graduate College within the specified time.

Students maker bound copies is at the student’s discretion. It is also advisable that students submit their
journal papers before leaving.

*Remember it is ultimately the responsibility of the student to ensure that all requirements
are met, not the advisor’s.*

4.2 Accelerated Master’s

The Accelerated Master’s Degree in Civil and Environmental Engineering allows for early admission to
graduate studies with the benefit of allowing up to six concurrent credit hours to be double-counted towards
the Bachelor’s and Master’s degree. Enrolling in this Program allows you to obtain your Master’s degree
with just one additional year of course work and research. Interested undergraduate students should contact
the Graduate Program Coordinator and our. Interested students must apply for admission in the spring of
their junior year and not later than August prior to their senior year. The details as to how to apply and
the required information can be found at [click here][9].

4.3 Doctoral Degree Requirements

The general requirements for the Degree of Doctor of Philosophy are outlined in the following sections. Some
of these are similar to those outlined in the M.S. program and in those cases the reader will be directed to
the previous sections. Table 2 lists some of the general requirements for the Ph.D. degree.

Table 2. General requirements of Ph.D. degree.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Details</th>
</tr>
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<tbody>
<tr>
<td>Total minimum number of credits*</td>
<td>75 approved credits</td>
</tr>
<tr>
<td>Total minimum number of research credits</td>
<td>35 credit hours</td>
</tr>
<tr>
<td>Course work required outside of CEE</td>
<td>6 credit hours</td>
</tr>
<tr>
<td>Significant teaching experience</td>
<td>1 semester</td>
</tr>
<tr>
<td>Course work required inside of engineering</td>
<td>18 credit hours</td>
</tr>
<tr>
<td>Comprehensive Examination (5 topical areas)</td>
<td>By end of year 2</td>
</tr>
<tr>
<td>Proposal Presentation</td>
<td>By end of year 2</td>
</tr>
<tr>
<td>Successful Dissertation Defense</td>
<td>Within 9 years</td>
</tr>
</tbody>
</table>

*includes research credits

4.3.1 Course work

The necessary course work is determined by the student and Studies Committee provided they meet the
general requirements of the Graduate College. A minimum of fifteen graded course credits is required by the
Graduate College.

There are no specific course requirements for the Doctoral Degree, however, the student and Studies
Committee should make course work decisions in order to address the following questions.

1. Will the course provide the knowledge needed for the qualifying examination (it is prudent to have taken a course from each member of the comprehensive examination committee to degree possible.

2. Will the course be necessary or useful for conducting the student’s dissertation research?

3. Will the course be necessary or useful for enhancing the student’s career?

There are topical area requirements for the comprehensive examination that should also be considered when selecting courses. Students are recommended to have the following credit hours in these general areas:

1. Six credits of graduate level course work in Statistics;
2. Six credits of graduate level computational modeling or advanced mathematics; and
3. Eighteen credits of graduate level engineering course work; i.e. course designated as CE xx, ME xx, or EE xx.

It is possible to transfer up to 24 credits of graduate course work from a M.S. program to the Ph.D. program upon approval by the Studies Committee and Graduate Program Coordinator.

Doctoral students may apply two 100-level, three credit courses to their program given prior approval by their Studies Committee. The student’s advisor must petition the Graduate College for approval prior to enrollment in the course. Under no circumstances will a course numbered below 100 be applicable to a doctoral program.

4.3.2 Significant Teaching Experience

All doctoral students must have a semester-long significant teaching experience. This experience goes beyond grading, running help sessions or setting up and helping in the laboratory. A significant teaching experience is one in which the student develops course materials (including several of the following: lectures, example problems, lab exercises, homework problems, quiz questions and examination questions), presents course materials to the students, and works with the students. Examples range from developing and presenting a module within an existing course, running the laboratory section of a course, or developing and teaching a new course. The best way to gage whether something is a significant teaching experience is to determine whether it is something that a typical Master’s-level teaching assistant would do. If it is, then it is not a significant teaching experience.

Students should discuss ideas on a significant teaching experience with the Graduate Program Coordinator and Advisor.

4.3.3 Comprehensive Examination

A comprehensive examination is required of all Ph.D. students and should be completed by the end of their second year in the doctoral program when they have taken at least 24 credits of graduate course work in different topical areas. Some or all of the 24 credits required may be transferred in from their Masters degree if desired. The comprehensive examination, successful proposal presentation, and one year of residency at UVM are needed for advancement to candidacy.

The comprehensive examination covers five topics or courses, from three topical areas. The three areas are described below.
Area 1. One topic from the following three;

1. Advanced Mathematical Methods (e.g. CE 304, 305)
2. Advanced Statistical Methods (e.g. STAT 231, STAT 225)
3. Probabilistic Methods (e.g. EE 270)

Area 2. Two topics from the following seven;

1. Water and Wastewater Engineering (e.g. CE 254, CE 255, CE 256)
2. Air Pollution, Hazardous Waste (e.g. CE 252, CE 253, CE 248)
3. Hydrology (e.g. CE 260, CE 360)
4. Groundwater (e.g. CE 265, CE 365)
5. Advanced Fluids (e.g. CE 261)
6. Advanced Civil Engineering Analysis (e.g. CE 226, CE 372)
7. Advanced Soils (e.g. CE 280, CE 282, CE 283)
8. Transportation Systems (CE241, CE245)

Area 3. Two topics from the following four;

1. Numerical Methods (e.g. CE 220)
2. Computational Modeling (e.g. CE 366)
3. Information Technology Applications (e.g. NR 285 (GIS), CS 256, CS 331)
4. Optional Area subject to approval by Studies Committee

Five members of the Comprehensive Examination Committee will test the student in five appropriate topics selected from the previous list. Each faculty member will be responsible for one of the five topics. Students generally select from courses that they have had at UVM, but occasionally a student may select a faculty member that they did not have, but covers a topic that they have taken. The student and their Advisor select the Comprehensive Examination Committee.

The examination takes place in two days and covers a written part (day 1) and an oral part (day 2). Each committee member makes up a written question or questions for the student that will take about an hour. The written examination is 6 hours long. The student usually answers three questions in the three and a half hour morning session and then two questions in the two and a half hour afternoon session. The questions can be closed book or open book. This is determined by each committee member. The student should talk to each committee member prior to the examination to determine the format and scope.

The oral examination is usually given two days after the written examination. This allows a day for the committee members to review the answer to their question, and the student to relax before
the oral examination. The oral examination requires three consecutive hours, a half an hour per examiner and a half an hour for the committee to reassemble and to decide if the student performed satisfactorily (S) or unsatisfactorily (U).

The student is responsible for coordinating the dates for the written and oral examination with their committee members, at least one month prior to the examination date. For the oral examination, all committee members must be present. Students will coordinate with the office of the Dean of the college or Program secretary to find a room for the oral examination. The student then gives to the Graduate Program Coordinator the list of members with e-mail addresses and phone numbers, and the dates of the examinations. The Graduate Program Coordinator solicits the questions from the examiners and administers the written examination to the student. The Graduate Program Coordinator then returns the examination to the appropriate committee members to be graded. The Graduate Program Coordinator schedules the examination times for each committee member. They each have a half of an hour. At the end of the two and a half hours, all of the committee members meet.

The Comprehensive Examination must be passed at least 6 months before submitting the dissertation. Success in the Comprehensive Examination is prerequisite for an oral Dissertation Defense Examination.

The comprehensive examination is graded Satisfactory or Unsatisfactory or Unsatisfactory with Committee’s recommendation to re-examine. The committee is under no obligation to allow a second (and final) sitting.

4.3.4 Time Limits and Residency

The maximum time for completion of the Ph.D. is nine years for all students. Leave of absences, withdrawal from the program and continuous registration are all outlined by the Graduate College and are strictly adhered to within these Programs.

Doctoral students must satisfactorily complete 51 credit hours in residence, of which at least 15 must be graded credits. This requirement is met by taking courses for graduate credit at UVM, as long as those credits are taken after a student has been admitted by the Graduate College to the program in Civil and Environmental Engineering.

4.3.5 Dissertation

The dissertation research generally takes three to six years to complete and depends primarily on the student’s background and experience. Students with an M.S. and previous research experience generally finish within four years. Students without an M.S. degree generally take five or more years to finish.

Students are required by the Graduate College to use a certain format for the Dissertation in terms of margins, fonts, and other details. The thesis must be prepared and submitted electronically as described in the Graduate College Electronic Thesis and Dissertation Guidelines (click here)\(^\text{10}\)

The Graduate College presents a yearly calendar outlining deadlines for defenses, and the submission of the dissertation and the appropriate forms in order to graduate by a certain time. This updated calendar and instructions for writing and submitting the thesis can be found on the Graduate College Web site (click here)\(^\text{11}\)

4.3.6 Dissertation Defense

Students must have completed their comprehensive examination and submitted their dissertation to the Graduate College for a format/record check before defending their thesis. They must also submit a notice to the Graduate College informing them of the date and title of the dissertation, and members of their Studies Committee one month prior to the defense date. The Studies Committee will act as the dissertation defense examination committee. All members must be Graduate College faculty members. The chair of the Studies Committee will be the graduate faculty member who is outside the student’s Program. The members of the Studies Committee must receive a copy of the thesis at least two weeks prior to the defense date. The format for the defense is the same as that discussed in the Thesis Defense Section of the M.S. Requirements.

The acceptability of the dissertation is determined by the Studies Committee. A grade of S or U is awarded. The student is allowed one re-examination if the examination performance was not satisfactory. After the defense, there may be numerous revisions required and the student should be aware of this possibility. After corrections have been made the electronic version of the thesis must be provided to the Graduate College within the specified time.

*Remember it is ultimately the responsibility of the student to ensure that all requirements are met, not the advisor’s.*

5 GRADUATE ACTIVITIES

5.1 Graduate Seminars

Faculty and graduate students within the Programs organize a weekly seminar series that operates both Fall and Spring semesters. **All students must sign up for CE 393, CE Graduate Seminar. All full-time students must regularly attend.** The seminar series includes a mixture of invited speakers (from academia and industry), faculty speakers (from the Programs and elsewhere at UVM) and graduate student speakers. The main reasons for the seminar series are to provide opportunity for:

1. students to annually present a talk on their research or other projects;
2. students to practice public speaking and oral presentation; and
3. students and faculty to get know each other’s work.

Seminar presentations are extremely beneficial for the students in that they get input from other faculty and students during their research phase. Another benefit of the seminar series is that it exposes the students and faculty to cutting edge research and innovative engineering applications by bringing in invited speakers from around the country.

Another important reason for a weekly graduate seminar series is that it provides an opportunity for faculty and graduate students to get together. This enhances the sense of community within the Programs. The graduate students alternate bringing in food and making coffee and the atmosphere preceding the formal talk is very friendly and collegial.

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12 Under unusual circumstances normally encountered near the date of graduation, a student may be excused from this requirement. See the Graduate Student Coordinator should you wish to be considered for this option.
5.2 Participation in National Scientific Meetings

All Master’s thesis students and Doctoral students should attend and present a paper at one scientific meeting during their tenure within the program. Generally, travel support funds are available through the advisor’s research grants, Program funds, or Graduate College “mini” travel grants. Applications for the mini grant are called for each fall and spring by the Graduate College (click here)\textsuperscript{13}.

5.3 Participation in Program Activities

All students are expected to participate in some of the various Program and University activities that occur. These include outreach activities to K-12 students, organizing the seminar series, faculty search committee members, conference organizing, university-wide committees on graduate education, meeting with Program visitors, and other activities. These are important for the student’s professional development as well as enhancing the Program as a whole.

6 FELLOWSHIPS AND FINANCIAL AID

Generally, all full-time graduate students within the Programs that do not have their own funding are funded on either Graduate Teaching Assistantships or Research Assistantships. These assistantships are initially awarded on a competitive basis based on the student’s application and experience, and on personal communications with faculty. Generally, upon maintenance of good standing within the program, the student will continue to receive funding throughout their stay.

6.1 Graduate Teaching Assistantships (GTA)

Teaching Assistantships are nine month appointments and provide a stipend and nine free credits per semester to a maximum of 75 total credits. A GTA is expected to assist in teaching courses for a maximum of 20 hours per week. Duties often include setting up and assisting in laboratories, grading, running help sessions, and tutoring students. Generally, students cannot receive GTA support for more than four semesters.

6.2 Graduate Research Assistantships (GRA)

Research Assistantships are supported by faculty research grants. A stipend and \textbf{nine free credits} per semester are provided (5 credits in summer for students on 12 month stipends) to a \textbf{maximum of 75 total credits}. Students assist the faculty member in their research, which is usually, although not necessarily, part of the student’s research.

6.3 Fellowship Grants

Students are encouraged to compete for national graduate fellowships, such as those made available by the National Science Foundation (NSF) or private foundations. Students should talk to their advisor about possible fellowship opportunities.

Students on Research Assistantships who exceed the 75 credit limit or who do not have financial support should look into the tuition payment plan so that they do not have to pay a large tuition bill at the beginning.

\textsuperscript{13}www.uvm.edu/~gradcoll/home.html
of each semester. In addition, direct deposit of paychecks is available for graduate students. You just need to go to the Payroll Office in Waterman and fill out a slip with a deposit and a voided check.

7 HEALTH INSURANCE

If you are a full time graduate student, i.e. you are taking nine or more credits, you are required to either enroll in the UVM Student Health Insurance Plan (SHIP) or demonstrate through an online insurance form that you have other insurance coverage. If you are registered for credits amounting to half-time or more i.e. you have signed up for five credits or for GRAD 902, you are eligible to enrol. Note that the Enrollment Period opens August 1 and closes September 15. Health insurance is very important!

8 COURSE INFORMATION

Current graduate course offerings within the Programs are found on the School of Engineering website (click here) by clicking Civil and Environmental Engineering followed by Courses. In addition, our graduate students typically take several mathematics and statistics courses because of their importance in engineering research and education. Courses typically taken by our graduate students from other departments are shown in Table 3.

<table>
<thead>
<tr>
<th>Table 3. Example Courses Often Taken by Civil and Environmental Engineering Graduate Students Outside of CEE</th>
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<tbody>
<tr>
<td>MATH 237 Introduction to Numerical Analysis</td>
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<tr>
<td>MATH 238 Introduction to Differential Equations</td>
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<tr>
<td>MATH 240 Fourier Series and Integral Transforms</td>
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<tr>
<td>MATH 268 Mathematical Biology and Ecology</td>
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<tr>
<td>MATH 264 Vector Analysis</td>
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<tr>
<td>MATH 266 Chaos, Fractals, and Dynamic Systems</td>
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<tr>
<td>STAT 201 Statistical Analysis Via Computer</td>
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<tr>
<td>STAT 211 Statistical Methods I</td>
</tr>
<tr>
<td>STAT 221 Statistical Methods II</td>
</tr>
<tr>
<td>STAT 223 Applied Multivariate Analysis</td>
</tr>
<tr>
<td>STAT 225 Applied Regression Analysis</td>
</tr>
<tr>
<td>STAT 231 Experimental Design</td>
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<tr>
<td>STAT 237 Nonparametric Statistical Methods</td>
</tr>
<tr>
<td>NR 270 Toxic and Hazardous Substances in Surface Water</td>
</tr>
<tr>
<td>NR 278 Principles of Aquatic Systems</td>
</tr>
<tr>
<td>NR 285 Geographical Information Systems</td>
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<tr>
<td>BOT 261 Plant Growth and Development</td>
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<tr>
<td>GEOL 352 Environmental Geology Seminar</td>
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<tr>
<td>GEOL 371 Critical Analytical Writing</td>
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<tr>
<td>CS 251 Machine Intelligence</td>
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<tr>
<td>CS 256 Neural Computation</td>
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14 http://www.uvm.edu/~cems/soc/?Page=Courses&category=CE&SM=grad/_gradmenu.html
8.1 Special Courses

Note that there are several extraordinary courses for which you may need to register. Research credits at the Master’s level are obtained by enrolling in CE 391 Master Thesis Rsch and Doctoral level thesis candidates enrol in CE 491 Doctoral Dissertation Research. In addition, once you have completed the required credits for you degree, you can enroll in Continuous Registration GRAD 901, 902 or 903 to maintain your required 5 credit enrolment demanded by tax law. Satisfactory performance in these courses requires both progress towards your degree and certification of effort. The site provided by the Graduate College (click here) provides the following

“Students who are actively working toward their degree completion and have completed all credits required for the degree, but have not completed all graduation requirements, must enroll each semester for Continuous Registration and pay a $100 Continuous Registration fee each semester until all degree requirements are completed, including removing incomplete grades, passing the comprehensive examination, or completing a thesis or dissertation.

Students who are working at the full time level of six or more credit equivalency register for XXXX 902 in their discipline. Students working at less than full time level (one to five credit equivalency) register for XXXX 901 in their discipline. (XXXX is replaced by the prefix corresponding to their degree program.)

Students who are not working towards completion of their degree and do not register in XXXX 901 or 902 for a period of one calendar year and are not on an approved leave of absence will be deactivated from the College. (See deactivation/reativation policy.)”

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9 APPENDICES

Student Record Forms
Programs of Civil and Environmental Engineering
University of Vermont
Student Record for the Master of Science Degree
(Return to Graduate Program Coordinator Yearly)

Name ________________________________

Date Matriculated into Program ________________________________

Thesis Advisor ________________________________

Studies Committee Members and Department

1) __________________________________________

2) __________________________________________

3) __________________________________________

Title/Subject of Thesis (Project)

Credits for Degree (30 Thesis, 30 Non-thesis)
<table>
<thead>
<tr>
<th>Course Number and Name</th>
<th>Grade</th>
<th>Credits</th>
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Research Credits Accrued (CE 391) ________________________________

Date of Thesis Proposal Presentation ________________________________
Dates of Studies Committee Meetings ________________________________
Thesis Defense Date ________________________________
Name _____________________________________________________________

Date Entered Program __________________________________________________

Dissertation Advisor Studies Committee Members and Department
1) ___________________________________________________________________
2) ___________________________________________________________________
3) ___________________________________________________________________
4) ___________________________________________________________________

Comprehensive Committee Members and Department
1) ___________________________________________________________________
2) ___________________________________________________________________
3) ___________________________________________________________________
4) ___________________________________________________________________
5) ___________________________________________________________________

Title/Subject of Dissertation ____________________________________________

_______________________________________________________________________

Date of Dissertation Proposal Presentation ________________________________

Dates of Studies Committee Meeting _____________________________________

Comprehensive Examination, Date Completed ______________________________
Course Credits for Degree

<table>
<thead>
<tr>
<th>Course Number and Name</th>
<th>Grade</th>
<th>Credits</th>
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Course Credits Transferred

<table>
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<tr>
<th>Course Number, Name and Institution</th>
<th>Grade</th>
<th>Credits</th>
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Research Credits Accrued (CE 491) 

Dissertation Defense Date
Programs of Civil and Environmental Engineering
University of Vermont
Dissertation or Thesis Proposal Defense Form
(Return to Graduate Program Coordinator)

Student Name ____________________________________________

Date of Proposal Defense ________________________________

Title of Proposal ________________________________________

Decision (pass, fail, retake) ______________________________

Studies Committee Members and Signatures
1) _______________________________________________________

2) ______________________________________________________

3) ______________________________________________________

4) ______________________________________________________

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