Graduate Student Handbook for the University of Vermont Electrical Engineering Graduate Degree Programs

The guidelines in this handbook are applicable for all students beginning their graduate studies on or after January, 2024. Students who started their degree program before this date are encouraged to transition to the requirements in this handbook, in consultation with their advisor and the Graduate Program Coordinator.

Contents

1 Introduction

The Electrical Engineering (EE) program at the University of Vermont (UVM) offers programs of study leading to the M.S. and Ph.D. degrees in Electrical Engineering. In addition,

the EE program partners with other academic units to offer M.S. and Ph.D. degrees in materials science and the Ph.D. degree in bioengineering. Areas of research expertise in electrical engineering include control systems, signal processing, electric power & energy systems, solid state physical electronics, semiconductor materials and devices, wireless communications, VLSI design & testing, and biomedical engineering.

This guide to the graduate program in Electrical Engineering at the University of Vermont is designed to help each student plan a program of graduate study leading to either, or both, the M.S. or Ph.D. degrees in electrical engineering. As such, it is devoted to the policies, rules, and procedures of our graduate program in Electrical Engineering with the intention of providing a general framework for your graduate studies. Any unanswered questions should be addressed to your faculty advisor, the EE graduate program coordinator, or the Graduate College. Notice that the program requirements for both the M.S. and Ph.D. degrees subsume the Graduate College requirements that are described in the Graduate Catalogue. It is the Graduate College that awards each graduate degree so that their rules must either be satisfied or subsumed by program rules. For general information regarding graduate studies at the University of Vermont, see the Graduate College website `http://www.uvm.edu/~gradcoll/`.

2 Electrical Engineering Graduate Program Faculty

The following full-time faculty members can advise students pursuing M.S. and Ph.D. degrees in Electrical Engineering:

- Professor Jeff Frolik (Ph.D., University of Michigan, 1995): Sensor networks, wireless communications, and distributed control.
- Professor Tian Xia (Ph.D., University of Rhode Island, 2003): Mixed Signal Circuit Design and Test, Adaptive Multifunctional Integrated Circuit Design, Reconfigurable Computing.
- Professor Josh Bongard (Ph.D., University of Zurich, 2003): Evolutionary robotics, machine learning and crowdsourced design.
- Professor Byung Lee (Ph.D. Stanford University, 1990): Database systems, data mining, causal modeling and causal query processing over data streams.
- Associate Professor Mads R. Almassalkhi (Ph.D., University of Michigan, 2013): Power/energy systems, distributed control, and predictive optimization.
- Associate Professor Hamid Ossareh (Ph.D. University of Michigan, 2013): Systems and control theory, constrained and predictive control, applications of control theory to automotive and power systems.
- Associate Professor Safwan Wshah (Ph.D. University of Buffalo, 2012): Machine & deep learning, image processing, computer vision.
- Assistant Professor Amber Doiron (Ph.D. University of Texas at Austin, 2008): Biomaterials, nanotechnology, molecular imaging, drug delivery, medical devices.

- Assistant Professor Luis Duffaut Espinosa (Ph.D. Old Dominion University, 2009): Control systems, stochastic processes, signal processing, estimation theory, algebraic combinatorics, and power systems.
- Dr. Matt Gallagher (Ph.D., Dartmouth College, 1994): Semiconductor engineering, Microelectronics, micro-controllers, and programmable devices.
- Assistant Professor David Jangraw (Ph.D. Columbia University, 2014): neuro-imaging, bio-signal processing, and systems engineering.
- Assistant Professor Amrit Pandey (Ph.D. Carnegie Mellon University, 2019): electrical energy systems analysis and modeling, optimization, and simulations.
- Assistant Professor Sam Chevalier (Ph.D. Massachusetts Institute of Technology, 2021): power/energy systems analysis, optimization, and machine learning.
- Assistant Professor David Bernstein (Ph.D. Boston University, 2021): systems biology, bioinformatics, computational modeling, machine learning, microbial ecosystems, modeling

Research Affiliates:

- Dr. Paul Hines (Ph.D. Carnegie Mellon Univ., 2007): Electrical energy systems and policy. Complex networks.
- Dr. Soumya Kundu (Ph.D. University of Michigan, 2013; Joint appointment): Power systems analysis, control, dynamics, and optimization.

3 Graduate Student General Requirements and Classifications

Graduate students in electrical engineering are classified as either Master of Science (M.S.) Program Students, Master of Science (M.S.) Candidates, Ph.D. Program Students, or Ph.D. Candidates. Each of these classifications is defined below along with general requirements that are common to all graduate students.

3.1 Electrical Engineering Core Requirement

Advancing to candidacy in any of the EE graduate degree programs requires that students demonstrate mastery of core electrical engineering material. The core EE material includes circuit analysis (EE 2125/2135, EE 2145, or EE 2175) and the material from at least two of the following courses:

- Analog Electronics (EE 3110)
- Microcontroller Systems (EE 3815) or Fundamentals of Digital Design (EE 2810)

- Electromagnetic Field Theory (EE 3100)
- Signals and Systems (EE 3150)

Students may demonstrate mastery in a subject by: (a) holding a bachelors' degree in electrical engineering from an accredited institution, (b) completing the class at an accredited institution with a grade of B or better, (c) completing a higher-level class that requires the core course as a prerequisite with a grade of B or better, or (d) auditing the class and completing the requisite exams with a grade of B or better. Each student who does not have an existing EE degree should obtain approval of their plan for completing the EE core requirement from the graduate program coordinator before the end of their first semester.

In addition to the undergraduate core above, EE 6110 (Systems Theory) and EE 6120 (Stochastic Processes) are considered core graduate courses. Ph.D. students are expected to complete both EE 6110 and 6120, and M.S. students are expected to complete at least one of these two EE graduate core courses.

All graduate students should be prepared to address questions related to the core EE material, as defined above, in their M.S. or Ph.D. comprehensive exams.

3.2 Graduate seminar

Seminars from UVM faculty or external visitors are an important part of a graduate education. Therefore, the EE program expects that graduate students attend research seminars, when announced.

3.3 M.S. Program Admission

Admission to the M.S. program requires an accredited bachelors' degree in engineering, physics, mathematics, computer science, or other appropriate field, an undergraduate grade point average above 3.0 (based on a 4.0 scale), strong grades in EE course (B average or better), and/or strong industry experience and recommendation letters. In borderline cases, additional information (such as a technical interview) may be used to evaluate candidates.

3.4 M.S. Candidacy

Requires either a bachelors' degree in electrical engineering from an accredited institution, or demonstrated mastery of core electrical engineering material, and completion of the M.S. Comprehensive Exam requirements.

3.5 Ph.D. Program Admission

Requires a M.S. degree in Electrical Engineering or its equivalent. A graduate student who meets the requirements for candidacy for the M.S. degree in Electrical Engineering and has completed twenty-four (24) credit hours of appropriate graduate course work with a B average (3.0 on a 4.0 scale) or better qualifies to apply to the Ph.D. program. An applicant to the Ph.D. program may be admitted provisionally based on a B average or better in

twenty-four (24) hours of appropriate graduate coursework toward the M.S. in Electrical Engineering.

3.6 Direct Ph.D. Program Admission after a B.Sc. degree

Exceptionally qualified and committed students may be considered for direct admission to the Ph.D. program, subject to advisor and graduate coordinator approval. Students who are interested in this path should specifically describe why they are interested to pursue the Ph.D. degree in their application essay.

3.7 Ph.D. Candidacy

Requires that the student complete the Ph.D. coursework requirements, complete the Ph.D. Comprehensive Examination, demonstrate mastery of core electrical engineering material (as defined previously), and successfully defend the student's dissertation proposal.

3.8 Admissions classification

After reviewing an applicant's materials, appropriately qualified applicants to our graduate program are either (1) admitted to graduate studies leading to the M.S. degree, or (2) admitted to graduate studies leading to the Ph.D. degree.

4 Requirements for the M.S. Degree in Electrical Engineering

The M.S. degree in electrical engineering requires, at a minimum, 30 credit hours at the 5000-level or higher, completion of the EE M.S. core requirement consisting of either EE 6110 (System Theory) or EE 6120 (Stochastic Processes), and the completion of a comprehensive examination. All courses should be selected in consultation with the student's graduate advisor in order to best prepare the student for their research and/or career objectives. To bolster their background in a particular area and with pre-approval from the graduate college and the student's advisor, a student may apply up to three credits of EE 2145 or higher coursework to their M.S. degree requirements.

Students may choose, in consultation with their graduate advisor, between a thesis option, a project option, and a coursework option. Students who are funded with a GTA or a GRA are required to choose between the thesis or project options, and may be required to pursue the thesis option, depending on the nature of their funding. Students are highly encouraged to check frequently with the Graduate College for UVM M.S. degree requirements and deadlines, which all graduate students are required to meet.

4.1 Comprehensive exam for M.S. students

Per Graduate College requirements all M.S. students are required to pass a comprehensive exam. Comprehensive Exams are meant to be "integrative", as in combining multiple

theorems/definitions/results/concepts from different EE courses/topics.

In all cases, the examination committee shall consist of at least two members of the electrical engineering faculty. For **students in the thesis or project options**, the thesis or project proposal and the comprehensive examination shall be completed simultaneously. In these cases the student should do the following:

- Form a committee in consultation with the students advisor or the graduate program coordinator.
- No later than the semester prior to the semester in which the student plans to graduate, schedule a time (typically 90 minutes) for the proposal/comprehensive examination with the exam committee. Once this time is scheduled, the student should notify the graduate program coordinator, who will invite all EE faculty members to attend.
- Submit a short (at least 1 page) written proposal to the committee at least 1 week in advance of the scheduled proposal/exam date. This document should also list the core EE courses that the student has taken, which may be discussed in the exam.
- Present to the committee, including a clear statement of the problem that the student is working to solve, a review of the background literature/technology, and any preliminary results obtained. The presentation should be not more than 30 minutes in length.
- At the end of the presentation, faculty members may ask questions about details of the proposal and/or topics related to the EE core. Subject (coursework) related questions are to be expected in particular when a student did not achieve a B or better in core EE classes.

Thesis or project students will be deemed to 'pass' the comprehensive exam if they demonstrate mastery of the core EE material (demonstrating an understanding of the material at the B+ level or higher) and a solid understanding of the material needed to successfully complete their thesis or project.

For **students in the coursework track**, the comprehensive exam process is as follows.

- Form a committee in consultation with the student's advisor or the graduate program coordinator.
- In the semester prior to the semester in which the student plans to graduate, submit to the committee a short summary (e.g., a copy of the student's transcript) of all EE coursework completed to date, including grades.
- If the student has completed their EE coursework requirements with grades of B+ or better the student will be considered to have passed the exam.
- If the student did not meet this threshold, the student should schedule a time (60 minutes) with the committee for an oral comprehensive exam. In this exam, faculty members should tell the student in advance the general topic areas that will be covered, and then during the exam the committee should ask questions and/or pose problems related to this material.

Coursework M.S. students will be deemed to 'pass' the comprehensive exam if they demonstrate mastery of the core EE material (demonstrating an understanding of the material at the B+ level or higher).

If a student does not pass the comprehensive exam in their first attempt, they may schedule one retake. If this second attempt is not successful, the student may be dismissed from the program without earning an M.S. degree, or may (in rare circumstances) be given additional assignments as needed to enable the student to achieve mastery of the material.

4.2 M.S. Thesis Option

The table below summarizes the requirements for the thesis option M.S. degree in EE.

Total credits	$\geq$ 30 credits selected with guidance from a graduate faculty advisor.
Coursework	$\geq$ 24 credit hours (at least 6 of which must be at the 6000-level). Selected with guidance from their graduate faculty advisor. • EE Coursework: ($\geq$15 credits) selected with guidance from a graduate faculty advisor, including either EE 6110 or EE 6120 graduate core classes. • Elective coursework ($\geq$9 credits): selected from EE or related graduate courses in science, technology, engineering and math, or thesis credits (EE 6391), selected with guidance from the student's advisor. • Accelerated MS program (AMP) double-credit for EE or elective coursework: (up to 6 credits) 5000-level or higher can be counted towards both UVM B.Sc. and M.S. degrees, subject to approval of graduate advisor.
Thesis research credits	$\geq$ 6 credits (EE 6391) under supervision of an EE graduate program faculty member
Thesis committee & Comprehensive exam	The student must orally present a proposal for their thesis research no later than the semester prior to the semester in which the student plans to graduate. After this presentation the student's thesis committee will orally examine the student based on the student's coursework and research focus, including the electrical engineering core and graduate core courses (e.g., EE 6110 or EE 6120). Successful completion of this step will meet the requirements for the comprehensive exam.
Thesis	A thesis must be completed, under the supervision of an EE graduate program faculty member. The written thesis must meet Graduate College requirements and be defended orally in public forum. See the Graduate College requirements.

4.3 M.S. Project Option

The table below summarizes the requirements for the project option M.S. degree in EE. Note that within the project option students are limited to 3 project credits of EE 6392.

Total credits	$\geq$ 30 credits, selected with guidance from a graduate faculty advisor.
Coursework	$\geq$ 27 credit hours (at least 6 of which must be at the 6000-level). Selected with guidance from their graduate faculty advisor. • EE coursework: ($\geq$15 credits) selected with guidance from a graduate faculty advisor, including either EE 6110 or EE 6120 graduate core classes. • Elective coursework ($\geq$12 credits): selected from EE or credits selected from EE or related graduate courses in science, technology, engineering and math, with guidance from the student's advisor. • Accelerated MS program (AMP) double-credit for EE or elective coursework: (up to 6 credits) 5000-level or higher can be counted towards both UVM B.Sc. and M.S. degrees, subject to approval of graduate advisor.
Project credits	3 credits (EE 6392) under supervision of an EE graduate program faculty member
Project committee	The student should work with their graduate advisor to choose a project committee by their second semester consisting of two to three regular faculty members, with not less than two from the EE graduate program faculty who approve the project.
Comprehensive exam	The student must orally present a proposal for their project research at least 3 months prior to graduation. The student's project committee will orally examine the student based on the student's project proposal as well as material from the EE core and graduate core courses (e.g., EE 6110 or EE 6120).
Project	The project topic is selected after consultation with an EE graduate faculty member and must not be the same as any project performed as part of a paid position. A written project report must be completed under the supervision of an EE graduate faculty member. The project should be orally presented in a public forum and approved by a committee of at least three faculty members, with not less than two from the EE graduate program faculty.

4.4 M.S. Coursework Option

The table below describes the requirements for the coursework option M.S. degree in EE. Note that only course credit hours will count towards this degree. Specifically, research or

project credits will not count, if the student transfers from Project-based or Thesis-based degree options to a the Coursework option.

Total credits	$\geq$ 30 credits, selected with guidance from a graduate faculty advisor.
Coursework	$\geq$ 30 credit hours (at least 6 of which must be at the 6000-level). Selected with guidance from their graduate faculty advisor. • EE coursework: ($\geq$15 credits) selected with guidance from a graduate faculty advisor, including either EE 6110 or EE 6120 graduate core classes. • Elective coursework ($\geq$15 credits): selected from EE or credits selected from EE or related graduate courses in science, technology, engineering and math, with guidance from the student's advisor. • Accelerated MS program (AMP) double-credit for EE or elective coursework: (up to 6 credits) 5000-level or higher can be counted towards both UVM B.Sc. and M.S. degrees, subject to approval of graduate advisor.
Exam committee	As needed to meet the requirements below, the student should work with their graduate advisor to choose a comprehensive exam committee consisting of two to three regular faculty members, with not less than two from the EE graduate faculty.
Comprehensive exam	Any student who demonstrates mastery in the EE core and completes their EE coursework requirements with a grade of B+ or better in all of the courses that meet this requirement, meets the requirements for a comprehensive exam. If the student does not meet this threshold, the graduate program coordinator and the student's advisor will jointly select two or more courses at the level of EE 5000 or above and will provide the student with an oral exam on this course material. The student must complete this exam at the B+ level or better.

4.5 Accelerated Master's Program

Qualified undergraduate students who plan to earn a thesis or project-based master's degree in Electrical Engineering may apply for the program's Accelerated M.S. Degree Program (AMP). This program enables the student to begin working on a master's degree while still an undergraduate student. The basic requirements for admission to and completion of this program are as follows:

- Interested students must apply to the Accelerated M.S. Program in the second semester of their junior year no later than April 15.
- In order to be admitted to the Accelerated M.S. Program, the student must have a cumulative grade point average of at least 3.2 at the time of application, and they

must submit a letter of application to the EE Graduate Program Coordinator naming an EE graduate program faculty member who has agreed to serve as their graduate advisor.

- Upon being admitted into the Accelerated M.S. Program, the student may take up to 9 credit hours of courses for graduate credit while still an undergraduate. Of these, up to 6 credit hours of 5000-level or higher courses can be counted toward both the B.Sc. and M.S. degrees, subject to the approval of the student's graduate advisor.
- Students in the AMP typically begin work toward their master's thesis or project starting in the summer following their junior year.
- All other requirements for the thesis or project option M.S. degree apply.
- AMP students may be eligible for early consideration for graduate teaching and/or graduate research assistantships.

5 Requirements for the Ph.D. Degree in Electrical Engineering

The Ph.D. degree in electrical engineering is designed to prepare students for advanced careers in engineering research, development and education.

Students seeking admission to the Ph.D. degree program are required to have completed the M.S. degree in Electrical Engineering or its equivalent, or to meet the qualifications for the direct-to-Ph.D. route.

Once admitted Ph.D. students much successfully meet each of the following requirements: (a) coursework, (b) comprehensive exam, (c) dissertation proposal, (d) dissertation defense, (e) final dissertation submission to the Graduate College.

The following sections describe each of these requirements.

5.1 Coursework

Per the Graduate College's requirements, the Ph.D. degree requires a total of seventy-five (75) semester credits total, with at least 51 credits taken in residence at UVM, and at least 30 credits in graded coursework of which at least 15 credits is not to be counted toward a student's master's degree. For the Ph.D. program in electrical engineering, these credits should be selected to meet the following requirements:

- Students should complete a coursework plan in their first year of Ph.D. studies, and submit this plan to the graduate studies committee for review.
- Two courses to satisfy the EE Ph.D. core requirement ($\geq$6 credit hours), which consists of EE 6110 (System Theory) and EE 6120 (Stochastic Processes). These courses are typically offered in alternate years in the fall semester. To achieve candidacy, students must complete two core courses with a C- or better grade.

- At least 9 credits at the 6000-level or above.
- At least three additional courses ($\geq$ 9 credit hours) of advanced topics in electrical engineering (5000 or higher) specifically selected with your graduate advisor to facilitate your research goals.
- To bolster a student's background in a particular area and with approval from a students advisor, the EE grad program coordinator, and the Graduate College, a student may apply three credits of EE 3000 or higher coursework to their Ph.D. degree requirements. These may not be applied to the 15 credits of EE coursework specified above.
- A student with a M.S. degree in Electrical Engineering can apply up to twenty-four (24) credit hours from their M.S. degree toward the Ph.D. coursework requirements, subject to the approval of the EE graduate studies committee.
- At least 20 credit hours of EE 7491, doctoral dissertation research, supervised by the student's Ph.D. advisor.
- Following the successful completion of all 75 required semester credits (from graduate courses and dissertation research), students requiring continuing registration must enroll in either GRAD 9010 (less than 50% effort), GRAD 9020 (50% effort), or GRAD 9030 (more than 50% effort) as a reflection of their current research activity.

5.2 Ph.D. Comprehensive Exam

In order to be advanced to candidacy for the Doctor of Philosophy in Electrical Engineering, a Ph.D. student is required to pass the Comprehensive Examination, prior to the start of a candidate's 4th semester of study, and no later than the end of the student's 4th semester (with the potential for an adjusted timeline for part-time students). The Ph.D. comprehensive exam is meant to be "integrative", as in combining multiple theorems/definitions/results/concepts from different EE courses and topics. Questions may go beyond any single theorem or result or definition to allow students to show that they have attained mastery of EE graduate core Materials at the PhD level.

Thus, to be eligible for taking the exam, the student must have successfully completed taking at least one of the EE graduate core courses (e.g., EE 6110 or EE 6120) with passing grades (C- or higher). Candidacy is achieved with successful completion of the comprehensive exam and successfully passing two EE core course (e.g., EE 6110 and EE 6120).

Part-time Ph.D. students should coordinate their schedule with their advisor and with the graduate program advisor.

The comprehensive exam consists of a written part and an oral part that must be presented to the Exam Committee.

The Exam Committee Composition

It is up to the Ph.D. student to work with their research advisor to construct a committee for their Comprehensive Exam. It is recommended to form this committee after the stu-

dent's first completed semester at UVM to ensure faculty availability. A Ph.D. student's Comprehensive Exam Committee must include at least three (3) faculty in the graduate college. At least two faculty committee members should be members of EE's graduate program and not the student's research advisor. The student's research advisor will serve as Chair of the Committee. Based on input from the Committee, the Student should schedule two (2) hours for the oral part of the comprehensive exam and share their CV and a list of EE Core graduate courses completed. The Committee Chair will then communicate back to the student the courses on which the student should focus to help them prepare for Oral Part (see below).

The Written Part

The written part of the examination will be a report presented in the form of an IEEE conference paper, with the format of double column and maximum length of 6 pages and **must be sent to the Committee at least two weeks before the Comprehensive Exam.** The paper will be focused on describing a proposed research topic in the area of the candidate's dissertation work at a level appropriate for the committee, and will comprise three Specific Aims.

1. Introduction, background and literature review related to the research problem. Development of a comprehensive bibliography related to their research topic.

2. A clear description of open issues related to the research topic. Discussion of the value and innovative aspects of the student's proposed research.

3. Proposed research approach description(s), hypothesis(es) and/or goal(s), potential barriers and possible solutions, preliminary data and/or results, and experimental design plan, if applicable.

The first aim will demonstrate the student's ability to collect and contextualize prior art in the area of research. The second aim will demonstrate the student's ability to identify new research problems and justify their value to the field. The third aim will be a "stretch aim" that extends beyond the completed aspects of the candidate's research. In this third aim, the candidate will be expected to exhibit evidence of an ability to generate imaginative and thoughtful hypotheses, and to think laterally about how their PhD research area could be developed in a new direction. The candidate should gain the approval of their thesis committee regarding the general area of the proposal prior to beginning work on it.

The Oral Part

The oral part of the comprehensive examination will be a formal presentation (25-30 minutes in length) by the student in front of the exam committee, to take place after the committee members have had a chance to review the written report. A student may (but is not required to) invite non-committee members (e.g., fellow students and family) to attend the presentation portion of the exam. After this presentation, the general audience will be dismissed to facilitate the technical examination with the committee. In the Oral Part, the student must successfully demonstrate mastery of core EE material and research topics by defending

their written part and answering additional questions related to the student's research and coursework completed in fulfillment of the Electrical Engineering Core Requirement. The student's research and electrical engineering core are important to passing the comprehensive exam. The Committee will meet after the Oral Part is complete to discuss the outcomes from the comprehensive exam.

Outcomes from the comprehensive exam

After the oral part of the exam, the exam committee will meet to discuss both the written and oral parts. The committee will then decide if the student

- Passed at the Ph.D. level and can proceed to complete the Ph.D. requirements.
- Passed at the M.S. level and will be allowed to retake the exam (1 time maximum).
- Did not pass the exam.

If the student does not pass at the Ph.D. level, but does pass at the M.S. level, the student may be allowed to complete work toward the completion of a M.S. degree.

After successful completion of the exam, the student may still need to complete his/her second EE core course (e.g., EE 6110 or EE 6120) with a C- grade or better to achieve candidacy. It is expected that Ph.D. students will complete their comprehensive exam no later than the start of their 4th semester of studies. If a full-time graduate student has not achieved candidacy by the end of their 4th semester of their Ph.D. studies, they may be terminated from the program.

5.3 Dissertation proposal

Nominally in their third year of study, a Ph.D. candidate will form a dissertation committee, in consultation with the student's research advisor. This committee should be composed of 4-5 members of the UVM Graduate College, with at least one member from outside of the EE faculty (to serve as Chair) and at least two members from within the EE graduate program faculty.

A dissertation proposal should be developed after the student has submitted at least one journal paper or very high quality conference paper (accepted) based on their research at UVM. The dissertation proposal, which is comprised of a written proposal with an oral presentation (open to the public), requires a comprehensive prior art review, a discussion of the student's work to date, and a detailed plan for the research that is expected to complete the dissertation.

While students should coordinate closely with their advisor regarding the exact structure of the proposal, specific recommendations for the proposal follow:

- Students should work closely with their advisor to select the committee, but it is ultimately the student's responsibility to select the committee and to schedule the proposal with the committee.

- Students should prepare a proposal document that reviews the students' research to date, the relevant literature and outlines the proposed content for the dissertation. This document should be shared with the committee and with the graduate college 2 weeks in advance of the actual proposal.

- The graduate college may have other requirements for the proposal. Students should check with the graduate college and make sure that they meet the graduate college requirements, particularly regarding public notification.

- The student should schedule at least 90 minutes for their dissertation proposal, including not more than 45 minutes of presentation and the remainder of the time for public questions, and then questions from the dissertation committee.

- The committee may recommend changes to the dissertation proposal. The student should work to address comments from the committee after the proposal presentation.

- Once the student has addressed comments from the committee the committee chair should notify the graduate college regarding the outcome of the proposal, which will be one of: pass, retake or fail.

5.4 Dissertation Defense

The dissertation defense is to be scheduled after the dissertation proposal has been successfully completed and approved by the dissertation committee, and the student has completed the proposed research.

The written dissertation should comprehensively describe the methodology and results from the student's research. The minimum standard for the dissertation is the completion of at least two and preferably three manuscripts appropriate for publication in a high quality, peer-reviewed venue, such as an IEEE transactions journal or a leading international peer-reviewed conference, at least one of which should be accepted for publication. Specific advisors may have additional requirements.

The dissertation defense is open to the public, and should include a comprehensive oral presentation of the student's research results, as well as questioning from the public and the student's dissertation committee.

While students should coordinate closely with their advisor regarding the exact structure of the dissertation defense, specific recommendations for the defense follow:

- It is the student's responsibility to schedule the defense with the student's selected committee and to ensure that all committee members are informed of the scheduled time, and to ensure that all graduate college requirements are satisfied including public announcements.

- The student should schedule two hours for their dissertation defense, including not more than 55 minutes of presentation and the remainder of the time for public questions, and then questions from the dissertation committee.

- Approximately 4 weeks in advance of the scheduled defense date, students should submit an abstract in accordance with graduate college requirements to the committee, the EE chair, and to the graduate college in order to ensure that public announcements can be made.
- 2 weeks prior to the scheduled proposal date, the student should share a draft dissertation document with the committee.
- After the student's defense, the committee may recommend changes to the dissertation document. The student should work to address comments per graduate college guidelines.
- Once the student has addressed comments from the committee the committee chair should notify the graduate college regarding the outcome of the defense, which will be one of: pass, retake or fail.

5.5 Final Dissertation Submission

The student is responsible to ensure that all comments from the committee are addressed and a final dissertation document is submitted to the Graduate College, in accordance with Graduate College requirements, for publication.

6 General information for graduate students

6.1 Graduate Program Applications

In order to be considered for admission to Electrical Engineering or Biomedical Engineering M.S. or Ph.D. programs, you will need to complete the UVM graduate admissions application process. In addition, if you are interested in financial support in the form of a Graduate Research Assistantship or a Graduate Teaching Assistantship you may wish to write to one of the program faculty members whose research interests align with yours. However, please note that offers of financial support can only be made after a student has completed the application process described below.

Checklist of Required Application Materials:

- Application (online): `https://www.applyweb.com/uvmg/`
- Resume
- Statement of Purpose
- Three Letters of Recommendation
- Transcripts: One official Transcript from each institution attended
- TOEFL/IELTS/DuoLingo Test Scores (*international students only*): These can be waived for the student, who has received a college degree from a University in where the official language of instruction is English (as stated on the official transcript).

- Application fee: paid with submission of online application

Note that since Fall 2020, we have not required GRE scores as part of the application.

Deadline for Application and Financial Aid

Fall Semester Enrollment: The official deadline is April 1. However the Department of Electrical and Biomedical Engineering will start the graduate application reviews and graduate assistantship position (GRA/GTA) allocations starting from January 15th, and will continue until all positions have been filled. Applicants are highly encouraged to complete their complete application packages submitted on or before January 15th.

Spring Semester Enrollment: The official deadline is November 15. However the Department of Electrical and Biomedical Engineering typically starts graduate application review and assistantship (GRA/GTA) allocation starting on October 1. Applicants are highly encouraged to complete their application packages before October 1.

Test Scores Requirement for English Proficiency Examinations

- **TOEFL or IELTS or DuoLingo score**: TOEFL or IELTS or Duolingo scores are required for an international student, who does not have a college degree from an accredited university where the official language of instruction is English. The minimum acceptable TOEFL/IELTS/DuoLingo scores for Graduate Teaching Assistant (GTA) funding is 100/7.0/120.

6.2 Funding Policies

In order to maintain a healthy level of activity in our graduate program, a proper balance must be maintained between the University supported GTA positions and externally supported Research Assistantships (GRA positions). In recruiting students, special attention must be given to diversity and excellence and capability of performing well as Graduate Teaching Fellows in the operation of our teaching laboratories and courses.

GTA funding is typically awarded only to Ph.D. and M.S. thesis option students with a priority given to full-time Ph.D. students.

In order to assist in the effort to locate qualified individuals and to help maintain a healthy stream of potential GRAs to our research programs, each faculty member will be encouraged to recruit (on average) at least one new graduate student annually. It will be the responsibility of each faculty member to both seek an individual that meets the goals stated above, and to initially welcome and advise that student once arriving at UVM. Once at UVM the student may elect to take any member of the EE Graduate Program Faculty as their advisor (with that faculty member's concurrence) without affecting their original graduate teaching assistantship.

The EE Graduate Program Faculty will discuss the awards of GTA positions in a meeting chaired by the EE Graduate Program Coordinator. The final decision regarding GTA allocation will reside with the Department Chair, and will be based on a number of factors including, teaching needs, student progress in research, and faculty rank of the advisor. All

the operational duties of the Graduate Program, such as organizing applications and assisting committees in administrating comprehensive examinations, will be performed by the EE Graduate Program Coordinator. Awards made during the summer will be coordinated with two members of the Graduate Program Faculty, if possible.

The potential faculty advisor may select a student who has originally stated an interest in pursuing a degree in either the Materials Science or Biomedical/Bioengineering Engineering Programs with their advisor in Electrical Engineering. If the student wishes to change to an advisor who is not a member of the EE Graduate Program Faculty, they will forfeit their GTA position.

6.3 Duration of GTA Funding

In general, students will not be offered more than one year of GTA funding.

Maintaining GTA funding requires that a student maintain good academic standing as evidenced by an overall GPA of 3.2 or higher, the completion of appropriate coursework, and acceptance as a thesis student by one of the EE Graduate Program Faculty, and adequately meeting all GTA responsibilities.

The performance of GTA-funded students will be reviewed midway through each semester in order to determine whether or not funding will be continued in the following semester. The final decision regarding GTA funding resides with the Department Chair.

6.4 Graduate Student Grants and Travel Funds

UVM's Graduate College provides information for graduate students seeking specific funding for academic, research, and travel endeavors. The Funding Manual for Graduate Students, which includes a list of graduate student fellowship competitions sponsored by such organizations as the National Science Foundation, the American Association of University Women, and the Ford Foundation, is updated each year and published in the Spring. This manual is available in the Graduate College and in the UVM Libraries. In order to assist graduate students in attending national meetings to present papers or poster, the Graduate College, through the Graduate Student Advisory Committee (GSAC), can provide some funds on a department matching-fund basis. Application forms are available in the Graduate College Office.

The Department of Electrical and Biomedical Engineering may provide a 1:1 match for funds obtained from the Graduate College to support student travel. Requests for these funds must be made via electronic mail to the Department Chair.

6.5 Information Available Online

The best place for updated information about graduate studies at UVM is the Graduate College web site: `http://www.uvm.edu/~gradcoll/`.

The following links may also be helpful.

Graduate Student Costs at UVM:

- Tuition and fees: `http://www.uvm.edu/~stdfinsv`

- Living and housing: `http://www.uvm.edu/studentlife` and `http://reslife.uvm.edu`

Application Procedure & General Information:

- Admissions web site with application deadlines: `https://www.uvm.edu/graduate/prospective_student_resources`
- UVM catalog: `http://www.uvm.edu/academics/catalogue`
- Graduate college: `http://www.uvm.edu/~gradcoll/`

The list of graduate college faculty is available here: `https://www.uvm.edu/graduate/graduate_faculty`

6.6 Cyril G. Veinott Award

The Cyril G. Veinott[1] (Graduate) Award, first given in 1989, is given annually to a senior graduate student in electrical engineering "for excellence in performance and greatest promise of success". Past recipients of the Cyril G. Veinott (Graduate) Award are:

- 2022 - Yasaman Pedari
- 2021 - Adil Khurram
- 2020 - Nawaf Nazir
- 2019 - Marcia Golmohamadi
- 2018 - James Jamison, III
- 2016 - Yu Zhang
- 2015 - Pooya Rezaei
- 2014 - Clark VanDam
- 2013 - Anbu Venkatachalam
- 2012 - Christopher Palombini
- 2008 - Richard P. Ketcham
- 2007 - Mohamed Elfataoui
- 2006 - Benji L. Capsuto
- 2005 - J. Brooks Zurn
- 2004 - Timothy J. Campbell
- 2003 - Seth A. Maciejowski
- 2002 - Jacob H. Galbreath

[1] Cyril G. Veinott (1905–2001) graduated from UVM in 1926 with a B.Sc. degree in electrical engineering and became the Chief Engineering Analyst of Reliance Electric Company. In 1977 he was awarded the IEEE Nikolai Tesla Award for "his leadership in development and application of small induction motors."

- 2001 - Thang V. Nguyen
- 2000 - Theodore M. Kawenski
- 1999 - Tien H. Nguyen
- 1998 - Hong Xiao
- 1997 - Matthew W. Deming
- 1996 - Valerie H. Chickanosky
- 1995 - Mohamed Z. Abd El Aziz
- 1994 - Paul D. Smith
- 1993 - Randall J. Landry
- 1992 - Judith Elizabeth Keil Laurens
- 1991 - Frederick L. Stone
- 1990 - William H. Tihen
- 1989 - Nicholas L. Volkringer