

ELECTRICAL AND COMPUTER ENGINEERING, PHD

Banner Code: EC-PHD-ECE

Academic Advising

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The PhD program in Electrical and Computer Engineering educates students to do original research on ECE topics and to become technical leaders in their fields. It has a strong and growing reputation, as graduates from the department have become professors at other universities and researchers in various industrial and government research centers. Students may choose a research emphasis in areas such as bioengineering, communications and networking, computer architecture and digital design, control and robotics, electronics, hardware security and cryptographic engineering, machine learning, mobile systems, space-based systems, and signal processing. The ECE PhD program requires coursework, a qualifying exam, a teaching assignment, a dissertation proposal and research competency exam, a research seminar, dissertation research, and a dissertation defense. Mason's general doctoral requirements apply to this program.

Admissions & Policies

Admissions

All general Mason and specific College of Engineering and Computing admission requirements apply. Applicants must submit official transcripts, a resume, a goals statement, and three letters of recommendation. Official GRE General Test results are not required for admission but should be submitted by students who consider applying for certain research fellowships.

For internationally educated applicants, a satisfactory score on any of the English proficiency examinations accepted by Mason is required. Satisfactory scores are specific to the College of Engineering and Computing. They are listed on the English Proficiency Requirements page (<https://www.gmu.edu/admissions-aid/apply-now/how-apply/international/english-proficiency-requirements/>) of the Mason website. Application materials are reviewed by the ECE PhD admissions committee.

Policies

Reduction of Credit

Students must complete a minimum of 72 graduate credits, which may be reduced by a maximum of 30 credits from a completed master's degree. Reduction of credit requires the approval of the program director or designee and the dean or designee of the school. They determine whether the credits are eligible for reduction of credit and applicable to the degree program and the number of credits to be reduced.

Program Requirements

The 72 hours of required doctoral-level credits typically consist of 48 credits of regular coursework and 24 credits of dissertation research. More than half of the 72 credits applied to the doctoral degree must be earned at Mason. The degree plan outlined in Degree Requirements is based on a student who receives a full 30 credit reduction. Students who do not receive a full credit reduction should choose additional credits in consultation with their advisor.

Requirements

Degree Requirements

Total credits: 72

Doctoral Coursework

Courses that constitute a student's plan of study will be chosen in consultation with the student's advisor and/or dissertation committee, to include:

Code	Title	Credits
Select 18-30 credits		18-30
Total Credits		18-30

- Students are strongly encouraged to take ECE 701 Research Experience in Electrical and Computer Engineering prior to or in the same semester as the Research Qualifying Examination. In certain circumstances, this course can be skipped with the permission of the student's advisor.
- A maximum of 21 credits of ECE 896 Directed Reading and Research. Note that ECE 698 and ECE 798 are primarily master's level courses and cannot be counted as part of the PhD coursework. However, if these courses were taken prior to the introduction of ECE 896, the total number of credits of ECE 698, ECE 798, and ECE 896 may not exceed 21.
- A minimum of 15 credits of coursework other than the individualized section courses, such as ECE 698, ECE 701, ECE 798, ECE 799, ECE 896, ECE 899, ECE 998, and ECE 999, or fulfilling the requirements of the MS in Computer Engineering or MS in Electrical Engineering degree at Mason on the way to the PhD degree using no more than 6 credit hours of individualized section courses, such as ECE 698, ECE 798, and ECE 799.
- A maximum of 9 credits may be at the 500-level¹

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For courses taken elsewhere, the equivalent levels are to be determined by the PhD advisor, subject to approval by the ECE Department chair.

Qualifying Exams

The ECE PhD Qualifying Exam (QE) tests students' knowledge of fundamental concepts and assesses their basic research skills. The exam consists of two parts: an in-class written technical qualifying exam (TQE) and a research qualifying exam (RQE). To pass the QE, a student must pass both the TQE and RQE. A student who fails the QE will be terminated from the program.

Technical Qualifying Exam

The Technical Qualifying Exam (TQE) tests knowledge of fundamental concepts in a particular technical area. Students select one of eight areas for their TQE:

1. Computer Architecture and Digital Design
2. Control Theory
3. Electronics and Circuits
4. Hardware Security
5. Machine Learning in Computing
6. Machine Learning in Electrical Engineering
7. Signals and Systems
8. Power and Energy Systems.

The TQE is offered once a year in January before the start of the Spring semester. Students are required to take the TQE the first time it is offered after they have entered the program. A student who fails the exam will have a second and final chance to pass the exam in the following year. A student who fails the written TQE twice will be terminated from the program.

Outstanding students may be exempt from the TQE if they obtain at least an A in two designated courses taken within the 24 months preceding the first attempt at the TQE, or within the twelve months after the student has failed the TQE in the first attempt. The designated courses are as follows:

- Area 1 - ECE 511 Computer Architecture and ECE 545 Digital System Design with VHDL
- Area 2 - ECE 521 Linear Systems and Control and ECE 528 Introduction to Random Processes in Electrical and Computer Engineering
- Area 3 - Any two of ECE 584 Semiconductor Device Fundamentals, ECE 586 Digital Integrated Circuits, ECE 587 Design of Analog Integrated Circuits, or ECE 684 MOS Device Electronics
- Area 4 - ECE 505 Hardware Security and ECE 545 Digital System Design with VHDL
- Area 5 - ECE 511 Computer Architecture and ECE 527 Learning From Data
- Area 6 - ECE 527 Learning From Data and ECE 528 Introduction to Random Processes in Electrical and Computer Engineering
- Area 7 - ECE 521 Linear Systems and Control or ECE 535 Digital Signal Processing and ECE 528 Introduction to Random Processes in Electrical and Computer Engineering.

Research Qualifying Exam

The purpose of the Research Qualifying Exam (RQE) is to assess whether students can define a research problem, critically review the literature related to the problem, apply appropriate research methods to study the problem, and interpret and communicate their results. The RQE requires students to complete a short research project and to document their results in a written report and an oral presentation. The RQE topic is defined by the student's faculty advisor in consultation with the student. A committee of three Mason Graduate faculty members, at least two of whom must be from the ECE Department (the student's advisor plus two additional members approved by the advisor), evaluates the written report and the oral presentation. During the presentation the student is expected to answer questions about their project and about fundamental concepts related to the research.

Students who enter the program with an MS degree are encouraged to start working on their RQE as soon as they enter the PhD program and no later than the start of their second semester in the program regardless of their performance on the TQE. These students are required to present their paper in the RQE exam no later than the end of their third semester in the program. Students who enter the program with a BS degree are required to take the exam prior to completing 30 credits in the program regardless of their performance on the TQE. A student is allowed only one attempt to pass the RQE. A student who fails the RQE will be terminated from the program.

Evaluation

The written research paper and the presentation will be evaluated using the following four criteria. Students must receive at least a "competent" rating (three on a scale of one to five) on each of the following four evaluation criteria to pass the RQE:

- Ability to articulate the research problem and its significance.
- Ability to critically review the literature.
- Understanding of research methods.
- Ability to communicate and interpret research results.

After a student has passed the TQE and has taken the RQE, the ECE PhD Committee reviews the exam results, the student's transcript, and a letter of recommendation from the student's advisor. Based on this information, the PhD Committee determines whether the student is qualified for the PhD program. A qualified student will proceed to choose a dissertation director.

Dissertation Research

A maximum of 24 credits of ECE 998 Doctoral Dissertation Proposal and ECE 999 Doctoral Dissertation may be applied to the degree. Students who choose to take fewer than 24 credits of ECE 998 Doctoral Dissertation Proposal and ECE 999 Doctoral Dissertation may earn the remaining credits from approved coursework. Students cannot enroll in ECE 999 Doctoral Dissertation before they have advanced to candidacy. Students advanced to candidacy after the add period for a given semester must wait until the following semester to register for ECE 999 Doctoral Dissertation. Students cannot advance to candidacy and defend their dissertation during the same semester. Once enrolled in ECE 999 Doctoral Dissertation, students must maintain continuous registration in ECE 999 Doctoral Dissertation each semester until graduation, excluding summers. Students who defend in the summer must be registered for at least 1 credit of ECE 999 Doctoral Dissertation during that summer term.

Code	Title	Credits
Select 12-24 credits from the following:		12-24
ECE 998	Doctoral Dissertation Proposal (minimum 9 credits required)	
ECE 999	Doctoral Dissertation (minimum 3 credits required)	
Total Credits		12-24

Advisor, Dissertation Director, and Dissertation Committee

Upon admission to the program, each student is assigned an ECE faculty member as an academic advisor. The role of an academic advisor is to advise the student on academic matters, primarily the plan of study, including what courses to take, etc., prior to the appointment of a dissertation director. The academic advisor must be a Mason graduate

faculty member in the ECE department with a full-time appointment. A student may request a change in academic advisor if they wish to work with a different ECE faculty member other than the one initially assigned at the time of admission.

The process of finding a dissertation director is governed by university (<https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-10-5>) and the College of Engineering and Computing policies (<https://cec.gmu.edu/academics/current-student-resources/graduate-student-handbook/>). After the student passes the qualifying exam, the student proposes and the ECE department chair, or their designee, approves a dissertation director who must be a College of Engineering and Computing graduate faculty member with a full-time appointment.

Often times, a student's initial academic advisor becomes their dissertation director. Normally, the dissertation director is a member of the ECE department; however, approval may be given for a dissertation director from another department if warranted by the student's proposed research topic and in this instance, it is strongly suggested that the student have a dissertation co-director from ECE.

A dissertation committee should be formed within a year after the student has passed the qualifying exam. The dissertation committee consists of the dissertation director who acts as chair plus three or four additional members. All dissertation committees must include at least three members of the Mason graduate faculty, at least two of whom must be from the ECE Department. At least one member of the dissertation committee must be from outside the discipline of electrical and computer engineering. The outside member may be faculty from another Mason department or, if justified by the research topic, a qualified scientist or engineer from outside the university. All committee members must have a doctoral level degree. The dissertation committee must be approved by the ECE department chair, or their designee.

Dissertation Proposal, Research Competency Exam, Advancement to Candidacy

The student prepares a written dissertation proposal outlining the proposed research and submits it to the dissertation committee for approval. After completing coursework requirements and preparing a proposal, the student takes a research competency exam to demonstrate their preparation for dissertation research. The exam consists of a presentation of the dissertation proposal followed by an oral exam. The exam is administered by the student's dissertation committee. The purpose of the oral exam is to verify that the student is familiar with the relevant material related to their research. The student is advanced to candidacy when they pass the oral exam and the dissertation committee approves the proposal.

Dissertation Research and Defense

Students conduct dissertation research under the guidance of their dissertation director, with regular consultation with other members of the dissertation committee. During this period, students must present their research results at least once in the form of a department seminar. The dissertation must represent an achievement in research, must be a significant contribution to its field, and should be deemed publishable in refereed journals or at highly selective conferences. On completion of the dissertation the student may be asked, at the discretion of the dissertation committee, to present a predefense in the presence of the committee members. The dissertation committee and the department chair approve the student's application for a public defense of the doctoral dissertation. A copy of the dissertation must be placed in the University Libraries four weeks prior to the public defense. After a successful public defense and completion of the final form of the

dissertation, the dissertation committee recommends the candidate for the degree of doctor of philosophy.

Seminar Requirement

The student must present at least one ECE departmental seminar on the topic of their dissertation research.

Teaching Requirement

To acquire teaching experience, each PhD student is required to participate in the department's teaching activity. The requirement is typically satisfied by working as a recitation instructor for one semester, presenting several lectures within a course, or performing other teaching work approved by the department.