

ENGINEERING, DOCTOR OF PHILOSOPHY (PH.D.) WITH A CONCENTRATION IN ELECTRICAL AND COMPUTER ENGINEERING

Program mission

The mission of the Ph.D. in Engineering degree program is to provide graduate students with learning opportunities for acquiring a broad foundation of engineering knowledge, an in-depth original research experience at the frontiers of engineering, and skills for lifelong learning and professional development. Graduates of this program will pursue careers in research and development or academia.

1. **Advanced research skills:** To produce graduates who possess the necessary advanced analytical, technical and research skills in engineering and the sciences – responds directly to the higher goal of fulfilling the needs of industry, academe and research laboratories for effective, productive engineers, professors and researchers
2. **Communication:** To produce graduates who possess a facility with both written and oral communications – emanates from the requirement that engineers, researchers and professors must be able to interact and share ideas with others in the work environment, and at a higher level, be capable of creative self-expression, conveying knowledge and leadership
3. **Advanced problem-solving:** To produce graduates who demonstrate creativity and innovation in solving technological problems – stems from the realization that new knowledge and new solutions to existing problems are necessary to meet the needs of our changing society and to advance the quality of human life

Student learning outcomes

1. **Apply advanced knowledge of mathematics, science or engineering:** Graduates will demonstrate an ability to apply advanced knowledge of mathematics, science or engineering.
2. **Communicate effectively:** Graduates will demonstrate an ability to communicate effectively.
3. **Identify, formulate and solve engineering problems:** Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
4. **Demonstrate abilities in research:** Graduates will demonstrate the ability to identify pertinent research problems, to formulate and execute a research plan, to generate and analyze research results, and to communicate those results through oral presentations and written publications. Graduates will be able to creatively solve the research problems posed.

VCU Graduate Bulletin, VCU Graduate School and general academic policies and regulations for all graduate students in all graduate programs

The VCU Graduate Bulletin website documents the official admission and academic rules and regulations that govern graduate education for all graduate programs at the university. These policies are established by the

graduate faculty of the university through their elected representatives to the University Graduate Council.

It is the responsibility of all graduate students, both on- and off-campus, to be familiar with the VCU Graduate Bulletin as well as the Graduate School website (<http://www.graduate.vcu.edu/>) and academic regulations in individual school and department publications and on program websites. However, in all cases, the official policies and procedures of the University Graduate Council, as published on the VCU Graduate Bulletin and Graduate School websites, take precedence over individual program policies and guidelines.

Visit the academic regulations section for additional information on academic regulations for graduate students. (<http://bulletin.vcu.edu/academic-regs/>)

Degree candidacy requirements

A graduate student admitted to a program or concentration requiring a final research project, work of art, thesis or dissertation, must qualify for continuing master's or doctoral status according to the degree candidacy requirements of the student's graduate program. Admission to degree candidacy, if applicable, is a formal statement by the graduate student's faculty regarding the student's academic achievements and the student's readiness to proceed to the final research phase of the degree program.

Graduate students and program directors should refer to the following degree candidacy policy as published in the VCU Graduate Bulletin for complete information and instructions.

Visit the academic regulations section for additional information on degree candidacy requirements. (<http://bulletin.vcu.edu/academic-regs/grad/candidacy/>)

Graduation requirements

As graduate students approach the end of their academic programs and the final semester of matriculation, they must make formal application to graduate. No degrees will be conferred until the application to graduate has been finalized.

Graduate students and program directors should refer to the following graduation requirements as published in the Graduate Bulletin for a complete list of instructions and a graduation checklist.

Visit the academic regulations section for additional information on graduation requirements. (<http://bulletin.vcu.edu/academic-regs/grad/graduation-info/>)

Other information

Student handbook (<http://www.egr.vcu.edu/current-students/graduate-student-services/resources-forms/>) is available on the College of Engineering website.

Apply online today. (<https://www.vcu.edu/admissions/apply/graduate/>)

Admission requirements

Degree:	Semester(s) of entry:	Deadline dates:	Test requirements:
Ph.D.	Fall (preferred)	Jun 1 (Jan 15 for financial assistance)	GRE-General; TOEFL or IELTS is required for international students
	Spring	Nov 15	

In addition to the general admission requirements of the VCU Graduate School (<http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements/>), applicants to the Ph.D. in Engineering with a concentration in electrical and computer engineering must have a B.S. degree in electrical and computer engineering or a closely related discipline. Acceptance of an applicant is based upon the recommendation of the admissions committee with approval of the program chair and the associate dean for graduate studies.

Degree requirements

In addition to the VCU Graduate School graduation requirements (<http://bulletin.vcu.edu/academic-regs/grad/graduation-info/>), students must meet the following requirements.

A minimum of 60 credit hours beyond the bachelor's degree, including research credit hours, is required for the Ph.D. in Engineering. Students holding the master's degree must complete a minimum of six credit hours in concentration course work and 21 credit hours in dissertation research. The student's adviser must approve all course work. Ph.D. students must take a minimum of 30 credit hours (including research) beyond the master's degree. No elective courses may be used for both M.S. and Ph.D. degrees. At least half of the didactic credit hours required in the student's program must be those designated as exclusively for graduate students, that is, at the 600 level or above. Students may not present courses receiving grades lower than B for fulfilling degree requirements. More than six credits of C grades or lower in the student's transcript will be considered unsatisfactory performance and may result in termination from the program.

A minimum of three years of study, including research, is necessary to complete all requirements for the Ph.D. A period of residence of at least three consecutive semesters is required. Residency is defined as registration for at least nine credits per semester. A time limit of eight calendar years, beginning at the time of first registration, is placed on work to be credited toward the Ph.D.

Comprehensive examination (also referred to as the Ph.D. qualifier examination)

In order to advance to doctoral candidacy, the student must pass the comprehensive examination that is composed of written and oral parts. The examination focuses on the subject matter deemed critical as a foundation in the program and in the student's research area. It is based on the material covered in required course work and its application to theoretical and practical problems, as well as assessment of the student's proficiency and ability to comprehend and explain new knowledge in his/her area of study. Graduate students may not take the comprehensive exam if their overall GPA is less than 3.0. Students must also have a minimum GPA of 3.0 for courses within the program in order to take the comprehensive exam. For further details, see the graduate program director or the program chair.

Proposal defense (also referred to as the Ph.D. candidacy examination)

The student should defend his/her research proposal within 36 months of enrollment. The purpose of the proposal defense is to assess the ability of the student to integrate information and display mastery of problem-solving capabilities in the chosen research area. The student is required to prepare a written dissertation proposal and to defend it in front of the doctoral advisory committee. The format of the proposal defense is an oral presentation by the candidate and questions by the doctoral advisory committee during and/or following the presentation. All committee members are required to vote, and a favorable decision with no more than one negative vote is required to pass the proposal defense. All members of the committee should be present at the dissertation proposal defense; in exceptional cases, the defense may go forward with one committee member other than the dissertation adviser absent, but the absent committee member must provide the student an opportunity to present and discuss the proposal before voting. Graduate students may not take the proposal exam if their overall GPA is less than 3.0. Students must also have a minimum GPA of 3.0 for courses within the program in order to take the proposal exam. For further details, see the graduate program director or the program chair.

Admission to candidacy

Before admission to doctoral candidacy, post-master's students must have completed all required course work and post-baccalaureate students must have no more than six credits of elective course work remaining. For candidacy, students must have also passed the comprehensive exam and the proposal defense and fulfilled all departmental requirements.

A student may seek admission to candidacy for the Doctor of Philosophy degree without first completing the research and thesis portion of the Master of Science degree.

Dissertation research

The student must conduct a substantial original investigation under the supervision of the permanent adviser and prepare a dissertation reporting the results of this research and analyzing its significance in relation to existing scientific knowledge.

When the dissertation has been completed, copies in accepted form and style are submitted to the members of the advisory committee. The committee members decide upon the acceptability of the candidate's dissertation. A favorable unanimous vote is required to approve the dissertation for defense and all members are required to vote.

If the advisory committee accepts the dissertation for defense, the candidate appears before them for a final oral examination. This examination is open to public and is limited to the subject of the candidate's dissertation and related matters. There shall be an announcement of the candidate's name, department and title of dissertation, together with the day, place and hour of the final oral examination at least 10 working days in advance. All members of the doctoral advisory committee must be present at the dissertation defense; in exceptional cases, the defense may go forward if no more than one committee member other than the dissertation adviser is absent, but the absent committee member has to provide the student an opportunity to present and discuss the dissertation before voting. A favorable vote of the candidate's advisory committee, which can include no more than one negative vote, shall be required for passing the final oral examination. All committee members must vote.

Publication requirement

Peer-reviewed evidence of the quality of the dissertation work, in terms of at least one accepted or published reputable journal paper or published high-quality conference paper and a second manuscript submitted to a journal or a high-quality conference, must be approved by the doctoral advisory committee and the ECE graduate program director before the dissertation defense can be scheduled. These publications should be based on the student's dissertation research, with the student as the primary author.

Curriculum requirements

M.S. to Ph.D. curriculum

Course	Title	Hours
Concentration component		
EGRE course work (EGRE 500-level or higher or courses approved by the advisory committee): This component allows the student to pursue a series of courses that focus on a specific field of engineering and serve as the student's primary engineering discipline.		6
Option electives		
Engineering or science course work (including 500-level courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE, PHYS, MATH, OPER, STAT, CHEM) approved by the advisory committee: This component allows the student to take courses in either engineering or science with approval of the student's adviser.		3
Directed research		
This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.		21
EGRE 697	Directed Research in Electrical and Computer Engineering	
Total Hours		30

For these students, the minimum total of graduate credit hours required for this degree is 30.

B.S. to Ph.D. curriculum

Course	Title	Hours
Concentration component		
EGRE course work (EGRE 500-level or higher or courses approved by the advisory committee): This component allows the student to pursue a series of courses that focus on a specific field of engineering and serve as the student's primary engineering discipline.		12
Option electives		
Engineering or science course work (including 500-level or higher courses in EGRE, ENGR, EGRB, EGMN, CMSC, CLSE, PHYS, MATH, OPER, STAT, CHEM) approved by the advisory committee: This component allows the student to take courses in either engineering or science with approval of the student's adviser.		21
Directed research		
This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.		27

EGRE 697	Directed Research in Electrical and Computer Engineering
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Total Hours **60**

For these students, the minimum total of graduate credit hours required for this degree is 60.

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Program website: electrical-and-computer.egr.vcu.edu/graduate (<https://egr.vcu.edu/departments/electrical/academics/graduate/>)