**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, academy 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-reg/grad/candidacy)

**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-reg/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-reg/grad/graduation-info)

**Other information**
Student handbook (http://www.egr.vcu.edu/current-students/graduate-student-services/resources-forms) is available on the School of Engineering website.

Apply online at graduate.admissions.vcu.edu (http://graduate.admissions.vcu.edu).

**Admission requirements**

<table>
<thead>
<tr>
<th>Degree</th>
<th>Semester(s) of entry</th>
<th>Deadline dates:</th>
<th>Test requirements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>Fall (preferred)</td>
<td>Jun 1 (Jan 15 for financial assistance)</td>
<td>GRE-General</td>
</tr>
</tbody>
</table>
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 advisor and submitted to the graduate program director for final approval.
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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concentration component</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td><strong>Option electives</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering or science course work (including EGRE, ENGR, EGRB, EGRM, CMSC, CLSE, PHYS, MATH, OPER, STAT, CHEM, 500 level or higher or courses 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.</td>
<td></td>
<td>3</td>
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<tr>
<td><strong>Directed research</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>EGRE 697 Directed Research in Electrical and Computer Engineering</td>
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</tbody>
</table>

**Total Hours** 30

### B.S. to Ph.D. curriculum

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Concentration component</strong></td>
<td></td>
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</tr>
<tr>
<td>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.</td>
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<td>12</td>
</tr>
<tr>
<td><strong>Option electives</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering or science course work (including EGRE, ENGR, EGRB, EGRM, CMSC, CLSE, PHYS, MATH, OPER, STAT, CHEM, 500 level or higher or courses 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.</td>
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</tr>
<tr>
<td><strong>Directed research</strong></td>
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<td></td>
</tr>
<tr>
<td>This component emphasizes research directed toward completion of degree requirements under the direction of an adviser and advisory committee.</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>EGRE 697 Directed Research in Electrical and Computer Engineering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Hours** 60

**Total graduate credit hours required (minimum)** 30

**Total graduate credit hours required (minimum)** 60

**Graduate program director**

Umit Ozgur, Ph.D.
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uozgur@vcu.edu

**Additional contact**

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(804) 828-1313

**Program website:** electrical-and-computer.egr.vcu.edu/graduate (http://electrical-and-computer.egr.vcu.edu/graduate)