Program:
PhD in Electrical Engineering

Department:
Electrical Engineering & Computer Systems

College:
Engineering and Applied Science

Year
2014

Primary Faculty:
Fred R. Beyette Jr.
513-556-4588
Fred.Beyette@uc.edu

Faculty Committee:
Member Name
Phone
Email

Member Name
Phone
Email

Member Name
Phone
Email

Member Name
Phone
Email
I. Program Overview

The role of electrical engineers in today’s society and economy are important and increasing. In 2007 Electrical and Computer Engineers held about 317,800 jobs nationally, making this the second largest branch of the U.S. engineering community. Employment market projections indicate continued strong growth in this field through the next decade and beyond. Manufacturers of electrical/electronic components, consumer electronics, computer/office equipment, industrial machinery, and professional, medical and scientific instruments employ most EE-PhD graduates in R&D. The military and defense, transportation, communications, information technology related sectors, government agencies and labs and universities also account for a significant proportion of EE-PhD employers.

There is no discipline today that is able to advance without aspects of electronics and computing. After a period stretching from the 60’s through early 90’s where EE programs thrived largely in service of their own discipline, the new paradigm has encouraged EE graduates to work as close collaborators in service to the world and other disciplines around us. For example, making a computer faster no longer gathers the interest/attention it did a decade ago, and now the interest is focused on how we can use and adapt that computer to address global challenges that threaten the safety and stability of the physical, social, economic, world we live in.

The opportunities for expansion within the field are truly limited by only the imagination of the students and faculty that make up the core of the EE program. As we have seen in recent years, electronic technologies have quickly transformed communications and information technologies into platforms that define human interaction, transform the political and social landscape and empower ever fast engagement of human innovation towards the solution of problems that transcend the global community.

Thus, the transformative nature of the Electrical Engineering discipline provides countless opportunities to convert today’s cutting-edge research into tomorrow’s engine of change. As a faculty our opportunities lie in working to carry out the basic and applied research that forms the cornerstones of tomorrow core technologies. Creating an environment where this research can flourish is a central activity that is a key to our success. Additionally, by creating an environment that encourages excellence in teaching and learning we promote a culture that values learning and ultimately instills in our students the core values and fundamental Electrical Engineering competencies that enable a cycle of technology innovation that can be sustained indefinitely into the future.

The PhD Electrical Engineering program is part of the Electrical Engineering and Computing Systems department within the UC College of Engineering and Applied Sciences (CEAS). Through its research and teaching components it is coupled with several other programs within the college and across the campus. It educates advanced students in electronic materials, devices, circuits, and systems where scholarship, intellectual discovery, and critical reasoning are the primary objectives.

The vision of the department of Electrical Engineering and Computing Systems (EECS) is to be internationally recognized as a global leader in our research endeavors and doctoral programs, to have faculty that support and engage in collaborations and activities with a
global perspective, and to provide an environment that will endow students with the experiences, knowledge and skills necessary to succeed in their professional and personal activities as members of an inextricably connected global community.

The mission of the PhD program in Electrical Engineering is to fully equip the students to be self-sufficient in pursuing new knowledge through research, innovation, and creation in all aspects of electronics and systems and to be adept at teaching/dissemination of such knowledge and leading others. Upon graduation, PhD EE students are able to identify and solve the most challenging electrical engineering problems, to innovate technologies that address problems that face modern society and create value for the stakeholders in their personal and professional lives. In short, they are primed to help define the future of the field of electrical engineering and its rapidly changing and highly specialized subfields.
II. Program Outcomes

Electrical Engineering PhD graduates will:

1. Acquire advanced level knowledge in subject areas related to electronic materials devices that extends beyond the undergraduate foundational knowledge.

2. Demonstrate the ability to apply critical thinking, engineering design and assessment skills (including determination of solution requirements, assessment of implementation constraints, solution evaluation and validation through simulation, operational testing on prototypes and/or analytical methods) towards the solution of engineering problems that involve electronic materials, devices and systems.

3. Demonstrate an ability to formulate a research question in an area related electronic materials, devices and systems.

4. Demonstrate the ability to conduct engineering focused research that advances state-of-the-art limits in areas related to electronic materials, devices and systems.

5. Demonstrate the ability to use both written and oral dissemination methods to report on research results associated with the electronic materials, devices and systems.
### III. Curriculum/Program Map

#### Curriculum Mapping Matrix: Linking Program Outcomes to Curriculum

<table>
<thead>
<tr>
<th>Key</th>
<th>Required Courses and Experiences* Identified in P-1</th>
</tr>
</thead>
</table>
| I/E: Introduced/Emerging  
D: Developing  
A: Achieved | Core Courses  
EECS 7001 Seminar I  
EECS 7002 Seminar II  
Dissertation Proposal  
Dissertation  
Oral Defense |
| OUTCOMES | |
| 1. Acquire advanced level knowledge that extends beyond the undergraduate foundational knowledge | I/E, D | D, A |
| 2. Apply critical thinking towards the solution of engineering problems that involve electronic materials, devices and systems. | I/E, D | D | A | A |
| 3. Formulate a research question in an area related electronic materials, devices and systems. | I/E | D, A | A | A |
| 4. Conduct engineering focused research that advances state-of-the-art limits in areas related to electronic materials, devices and systems. | I/E | I/E | D | A | A |
| 5. Use both written and oral dissemination methods to report on research results associated with the electronic materials, devices and systems. | I/E | D, A | A | A |

* Please note that you are only identifying required courses and experiences that are house with in your academic unit.
## IV. Methods and Measures

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Assessment Tools</th>
<th>Course / Experience</th>
<th>Time Line</th>
<th>Responsible Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acquire advanced level knowledge that extends beyond the undergraduate foundational knowledge</td>
<td>Score from one selected comprehensive assignment (exam, project, paper etc.) from each core course.</td>
<td>Students are required to select 3 courses from a set of 5 core course designated for their track (Electronic Materials and Devices, Systems, VLSI Design)</td>
<td>Annually</td>
<td>Course Instructors</td>
</tr>
<tr>
<td></td>
<td>Knowledge Foundation Self Assessment Review</td>
<td>Students are asked to prepare a self-assessment (format guidelines provided) that comments on their knowledge level preparedness for conducting their research project. This document is included with the materials submitted for the dissertation proposal. This self assessment document is reviewed and scored by the members of their dissertation committee</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td></td>
<td>Rubric completed by members of dissertation committee</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Apply critical thinking towards the solution of engineering problems that involve electronic materials, devices and systems.</td>
<td>Dissertation Proposal Review</td>
<td>Students write a project proposal based on proposal guidelines that have been adapted from NSF and NIH proposal guidelines. In addition to submitting their written proposal for review by their dissertation committee, they make a 45 min oral presentation based on their dissertation proposal.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td></td>
<td>Rubric completed by members of dissertation committee</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissertation Review</td>
<td>Students write a dissertation that describes their research question and the conclusions drawn from the research results.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td></td>
<td>Rubric completed by members of dissertation committee</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Formulate a research question in an area related electronic materials, devices and systems.</td>
<td>Dissertation Proposal Review</td>
<td>Students write a project proposal based on proposal guidelines that have been adapted from NSF and NIH proposal guidelines. In addition to submitting their written proposal for review by their dissertation committee, they make a 45 min oral presentation based on their dissertation proposal.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td></td>
<td>Rubric completed by members of dissertation committee</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Methods and Measures (Cont.)

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Assessment Tools Responsible Person, Course(s) and Time frame</th>
<th>Course / Experience</th>
<th>Time Line</th>
<th>Responsible Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Conduct engineering focused research that advances state-of-the-art limits in areas related to electronic materials, devices and systems.</td>
<td>Dissertation Proposal Review Rubric completed by members of dissertation committee</td>
<td>Students write a project proposal based on proposal guidelines that have been adapted from NSF and NIH proposal guidelines. In addition to submitting their written proposal for review by their dissertation committee, they make a 45 min oral presentation based on their dissertation proposal.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td></td>
<td>Dissertation Review Rubric completed by members of dissertation committee</td>
<td>Students write a dissertation that describes their research question and the conclusions drawn from the research results.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td>5. Use both written and oral dissemination methods to report on research results associated with the electronic materials, devices and systems.</td>
<td>Dissertation Proposal Review Rubric completed by members of dissertation committee</td>
<td>Students write a project proposal based on proposal guidelines that have been adapted from NSF and NIH proposal guidelines.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td></td>
<td>Dissertation Proposal Presentation Review Rubric completed by members of dissertation committee</td>
<td>In addition to submitting their written proposal for review by their dissertation committee, they make a 45 min oral presentation based on their dissertation proposal.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td></td>
<td>Dissertation Review Rubric completed by members of dissertation committee</td>
<td>Students write a dissertation that describes their research question and the conclusions drawn from the research results.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
<tr>
<td></td>
<td>Oral Dissertation Defense Review Rubric completed by members of dissertation committee</td>
<td>In addition to submitting their dissertation for review by their dissertation committee, they make a 45 min oral presentation based on their research problem and research results described in their dissertation.</td>
<td>Annually</td>
<td>Dissertation Committee Chair</td>
</tr>
</tbody>
</table>
V.  **Assessment Infrastructure**

This section provides a brief overview of the assessment infrastructure required to implement this assessment plan. Specifically, this section

- Identifies the various participants in the assessment process and describes their role in the process.
- Details the data collection/review process including data collection methods, data collection frequency, data review frequency and how/when the assessment data is presented to the faculty and other program stakeholders.
- Describes how the assessment data is used to inform processes for program improvement

**Program Assessment Participants**

**Core Course Instructors:** Instructors for all “Core” graduate courses in Electrical Engineering (currently 9 courses) identify and submit grades for one graded student activity (i.e. exam, project, paper etc.) that provides a broad reflection of the student’s mastery of the core technical content covered by their course.

**Dissertation Committee Members:** Dissertation committee members complete assessment rubrics for each of the key assessment events (i.e. dissertation proposal, dissertation, oral dissertation defense). Rubrics are multi part designed to assess the various learning outcomes that are being evaluated during the assessment event.

**Dissertation Committee Chair:** In addition to completing the assessment rubric associated with each assessment event, the dissertation committee chair is responsible for collecting all assessment rubrics and submitting them to the EECS graduate council for compilation, review and analysis.

**EECS Graduate Council:** The EECS graduate council has ultimate responsibility for management and oversight of all graduate programs in the Electrical Engineering & Computer Systems Department. With regards to assessment, the EECS graduate council is responsible for

- Generation/distribution of the assessment rubrics.
- Requesting assessment data and reminding responsible faculty when the assessment data is overdue.
- Compilation, review and analysis of the assessment data.
- Reporting of assessment results to the EECS faculty.
- Determining/Enacting curricular changes to the EE-PhD program in order to address deficiencies revealed by the assessment process.

**EECS Graduate Program Director:** The EECS Graduate Program Director chairs the EECS Graduate Council and coordinates. In addition to leading the efforts of the EECS Graduate Council, the EECS Graduate Program Director has primary responsibility for reporting program details to the department faculty, department head, college graduate office and the graduate school.
NOTE: it should be noted that the Graduate Program Director and the members of the Graduate Council receive workload consideration for their service in support of the EECS graduate programs.

Data Collection/Review Process:

Data Collection Methods:

Core Course Assessment: The core course assessment is a course assignment score for a single assignment selected by the course instructor. The instructor will be reminded at the beginning of each term that a set of scores (one score for each student enrolled in the course) will be required for assessment purposes. The due date for submission of this assessment data is the same as the course grade submission deadline (typically CoB on the Wednesday following the end of the term).

Dissertation Proposal Assessment Rubric: All member of a student’s dissertation committee complete the Dissertation Proposal Assessment Rubric during or immediately after the dissertation proposal presentation. Each committee member (evaluator) may use the written dissertation proposal, the Knowledge Foundation Self Assessment, the dissertation proposal oral presentation or questioning/dialogue with the student as appropriate to inform their assessment of the student’s current level of achievement for each of the learning outcomes being assessed.

The dissertation proposal assessment rubric includes sections for assessment of:

- Knowledge Foundation (Program Outcome #1)
- Critical Thinking (Program Outcome #2)
- Research Question Formulation (Program Outcome #3)
- Research Execution (Program Outcome #4)
- Use of Written and Oral Dissemination Methods (Program Outcome #5)

For each section, the rubric guides the evaluator towards a numeric score that corresponds to the student proficiency level towards achievement of the specific program outcome. In addition, the rubric includes space for providing details regarding performance deficiency that may be a significant concern to the evaluator. For example, if the evaluator determines from his/her review of the Knowledge Foundation Self Evaluation and discussion with the student that the student is deficient in a specific topic that should have been covered in a core course then the evaluator can make a note (with specific details) of the deficiency.

Distribution of the assessment rubric to the committee members and collection/submission of the completed rubrics is the responsibility of the dissertation committee chair.

The faculty will be reminded at the beginning of each academic term that this assessment is required for all students who complete the dissertation proposal. The completed assessment rubrics are due within 2 day of the dissertation proposal oral presentation. The EECS Graduate Program Director will be responsible for
confirming that completed rubrics have been submitted and sending reminders as appropriate. Graduate Director signing of the “Pass/Fail” form required by the college graduate office triggers this check/remind step.

**Dissertation Defense Assessment Rubric**: All member of a student’s dissertation committee complete the Dissertation Defense Assessment Rubric during or immediately after the Dissertation Defense Oral Presentation. Each committee member (evaluator) may use the written dissertation, the dissertation oral defense presentation or questioning/dialogue with the student as appropriate to inform their assessment of the student’s current level of achievement for each of the learning outcomes being assessed.

The dissertation oral defense assessment rubric includes sections for assessment of:

- Critical Thinking (Program Outcome #2)
- Research Execution (Program Outcome #4)
- Use of Written and Oral Dissemination Methods (Program Outcome #5)

For each section, the rubric guides the evaluator towards a numeric score that corresponds to the student proficiency level towards achievement of the specific program outcome. In addition, the rubric includes space for providing details regarding performance deficiency that may be a significant concern to the evaluator. For example, if the evaluator determines from his/her review of the dissertation and discussion with the student that the student is deficient in their mastery of a specific research method then the evaluator can make a note (with specific details) of the deficiency.

Distribution of the assessment rubric to the committee members and collection/submission of the completed rubrics is the responsibility of the dissertation committee chair.

The faculty will be reminded at the beginning of each academic term that this assessment is required for all students who complete the dissertation oral defense. The completed assessment rubrics are due within 2 day of the dissertation proposal oral presentation. The EECS Graduate Program Director will be responsible for confirming that completed rubrics have been submitted and sending reminders as appropriate. Graduate director signing of the “Pass/Fail” form required by the college graduate office triggers this check/remind step.

**Data Review and Assessment Reporting Methods**:

As described above, data will be collected on an ongoing basis. Score data will be entered into a spreadsheet that is maintained by the EECS Graduate Council. After completion of the Spring Term, the Graduate Council will review all assessment data collected during the previous 12 months. Based on this review, the Graduate Program Director will prepare a report to be presented to the EECS faculty at the Fall Retreat (or first faculty meeting of the Fall Term if a Fall Retreat is not held).
Process for Program Improvement:

There are essentially two forms of assessment data collected in the process detailed in this document. All of the assessment methods described above generate a numerical score that is indicative individual student achievement towards the mastery of the program outcomes. In addition to the numerical assessment scores, there may also be open response data generated when an evaluator perceives a significant program deficiency.

The Graduate Council treats deficiency comments in assessment rubrics as command response items, which automatically generate further investigation and immediate corrective action warranted.

Faculty response to the annual assessment report (presented at the fall faculty retreat or the first fall term faculty meeting) will be noted by the graduate council and discussed at the next regular meeting of the Graduate Council. As needed, the Graduate Director will work with the Graduate Council to enact corrective policies/practices to address concerns identified by the annual review of program assessment data.

Regardless of which mechanism initiates a need for corrective action, the Graduate Council will consider all possible mechanisms for effecting a positive change in the program outcome assessment. In most cases the Graduate Director and the Graduate Council seek to work directly with the faculty member(s) who are best positioned to enact the necessary curricular changes. When/If direct faculty interaction is insufficient or in circumstances where significant department resources are needed to effect a positive change, then the Graduate Director will work with the Department Head and/or the college administration to create effective solutions.