Program Performance Review
Visit Date: March 9, 2022

Electrical Engineering Department
Master of Science

California State University, Fullerton

Review Summary

March 2022

External Review Team:

Scott Shumaker
Jay Farrell
Wylie Ahmed

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1.   Introduction

A team of three external reviewers; Scott Shumaker, Jay Farrell and Wylie Ahmed were invited to review the Master of Science Degree Program of the Electrical Engineering Department at California State University, Fullerton. This document outlines the feedback from the external reviewer team.

2.   Program Review Process and Overview

Department Chair of Electrical Engineering Dr. Jidong Huang invited the three external reviewers to prepare a Program Performance Review (PPR) feedback document for the Master of Science in Electrical Engineering at California State University, Fullerton. This team reviewed the CSUF MS Self-Study Report document, did a site visit on March 9, 2022, and wrote this report document.

Review Team:

Mr. Scott Shumaker, Director of Engineering, Advanced Charging Technologies

Dr. Jay Farrell, IEEE Fellow and Professor of Electrical & Computer Engineering, UC Riverside

Dr. Wylie Ahmed, Associate Professor of Physics, CSUF

Schedule of Activities for the Review:

February 28, 2022 - Review team selected, and introductions made via email

March 4, 2022 - Review team video conference and review discussion

March 7, 2022 - Reviewers receive Self-Study Report

March 9, 2022 - External Reviewers visit California State University, Fullerton

3. Campus Visit Schedule

CSUF MSEE Program Performance Review

Campus Visit Schedule

Wednesday, 3/9/2022

8:00 to 9:00am	Breakfast
9:00 to 9:50am	Review Team Meeting (E-101)
10:00 to 10:50am	Meeting with ECS Dean: Dr. Barua (E-101)
11:00 to 11:30am	Meeting with EE Graduate Advisor: Dr. Hamidian (E-101)
11:45 to 1:15pm	Lunch and Meeting with EE Students (E-101)
1:30 to 2:00pm	Meeting with EE Faculty: Drs. Chaudhry ~~and Hashemi~~ (E-101)
2:00 to 2:30pm	Meeting with ECS Associate Dean: Dr. Oh (E-101)
2:30 to 3:00pm	Meeting with EE Faculty: Drs. Cheng and Shiva (E-101)
3:00 to 3:30pm	Meeting with EE Faculty: Drs. Grewal and Tehrani (E-101)
3:45 to 4:15pm	Meeting with EE Dept Chair: Dr. Huang (E-101)
4:15 to 4:45pm	Meeting with EE Faculty/Staff: PTF and Technicians (E-101)
4:45 to 5:25pm	Review Team Meeting (E-101)
5:30 to 6:45pm	Class Visit: EGEE-537 Satellite Communications (E-321)

4. Executive Summary

Electrical Engineering is a vibrant field. For example, its main professional organization, IEEE, is "the world's largest technical professional organization for the advancement of technology" with 39 societies focused on the different dimensions of the field. Many universities have strong cooperative educational programs on both Electrical Engineering (EE) and Computer Engineering (CpE). Often these are organized within a single Electrical and Computer Engineering department. Key to the strength is the support and vibrancy of both the EE and CpE programs.

The present situation at CSUF does not ensure the viability of the EE program. The absence of recent faculty hires has contributed to the recent decline in enrollment. However, the student headcount graphs in Fig. 1 show an increase of over 200% from 2010-2016. During that same time period, the faculty size decreased by about half, without any replacement hires. Currently, the department has 10 faculty with 3 in the Faculty Early Retirement Program (FERP). This decrease in EE faculty to 7 over the next few years threatens the viability of the EE program.

The CSUF MSEE program was once strong and is well positioned to regain its strong position, with its central location in the Southern California region that has a high need for well-trained electrical engineers. On the other hand, Southern California contains various high-quality EE MS programs. Building and retaining high-quality and competitive programs requires commitment, engagement, and planning.

The main challenges observed by the PPR committee are:

1) The absence of a strategic plan to ensure the quality and viability of the EE degree programs. This plan must address the two key issues of faculty hiring and student enrollment. The University, through the Dean, must be willing to commit resources and the faculty must be committed to engagement in high quality outreach, research, thesis advising, and service. The EE faculty must be willing to work together to create the strategic plan.
2) The absence of an agreement between the EE faculty and the ECS Dean concerning expected faculty workload and the commitment of resources to support this workload. For example: the PPR team strongly recommends that the faculty engage in graduate project and thesis advising, the Dean should also recognize this advising as a form of teaching and account for it in the teaching workload calculations.

Annualized Headcount - EE 2000-01 to 2021-22

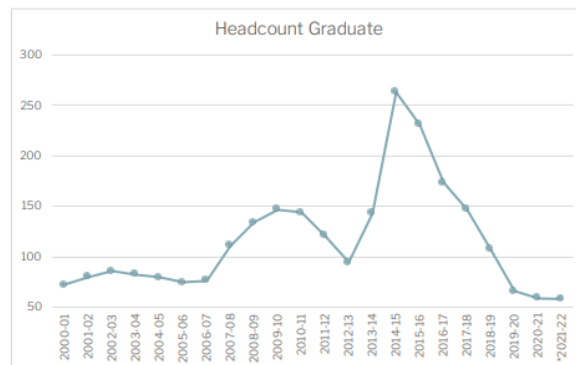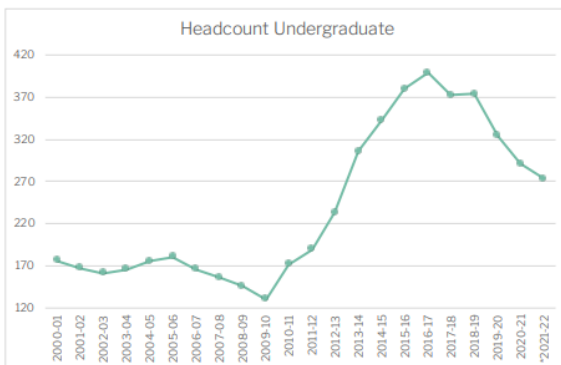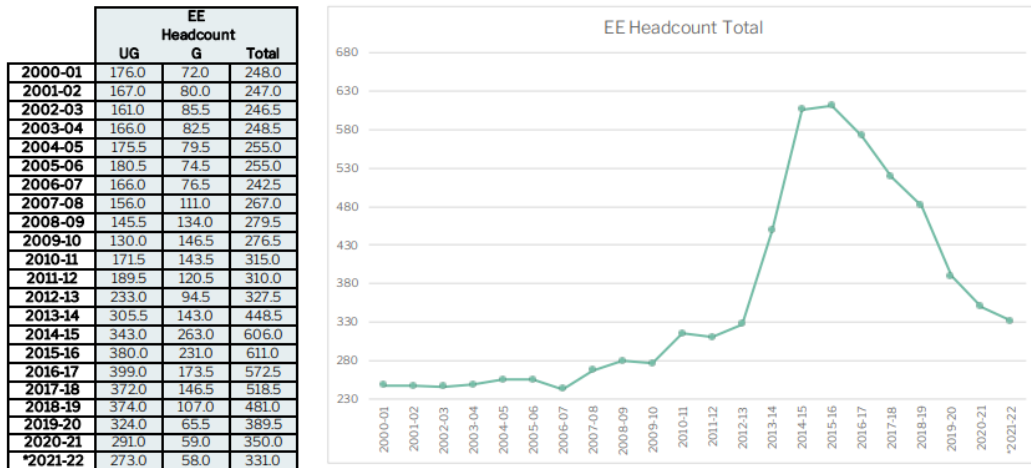| | EE Headcount | | |
	UG	G	Total
2000-01	176.0	72.0	248.0
2001-02	167.0	80.0	247.0
2002-03	161.0	85.5	246.5
2003-04	166.0	82.5	248.5
2004-05	175.5	79.5	255.0
2005-06	180.5	74.5	255.0
2006-07	166.0	76.5	242.5
2007-08	156.0	111.0	267.0
2008-09	145.5	134.0	279.5
2009-10	130.0	146.5	276.5
2010-11	171.5	143.5	315.0
2011-12	189.5	120.5	310.0
2012-13	233.0	94.5	327.5
2013-14	305.5	143.0	448.5
2014-15	343.0	263.0	606.0
2015-16	380.0	231.0	611.0
2016-17	399.0	173.5	572.5
2017-18	372.0	146.5	518.5
2018-19	374.0	107.0	481.0
2019-20	324.0	65.5	389.5
2020-21	291.0	59.0	350.0
*2021-22	273.0	58.0	331.0

*fall only

Figure 1. EE Department student headcount. From the ECS Dean's website.

Smaller, yet important, issues:

- Course cancellations, especially for required courses, are problematic. The PPR committee heard various perspectives. (1) It can force students into alternative career directions due to the need to graduate or cost them additional time and money to wait to get the courses they need. (2) The University cannot afford to teach low enrollment courses. (3) The program can structure its course offerings such that there are fewer competing courses. (4) The University can work closely with the department to understand and shape course enrollment prior to cancellation to achieve less impact on students.
- Enrollments are highly skewed between departments, with CS much larger than the others. It would be beneficial to all programs in ECS to work with CSUF for some form of enrollment/admissions management.

- It is encouraged to incorporate more modern teaching methods and materials into the classroom to further engage students and take advantage of more recently developed technologies. Rather than projecting older and hard-to-read handwritten notes, technologies such as PowerPoint facilitate the maintenance of up-to-date teaching materials.

Following is a list of suggestions from the various persons whom the PPR committee met with:

- The MS students would like more opportunities to engage with their peers and professors in a social format.
- IEEE and Engineering Design Club meetings offer opportunities for MS students to engage with undergraduates, but MS students appear to be unaware of such events.
- All courses should have syllabi available the first week including: list of topics by week; test dates; project deadlines; and textbook. These items might change over the semester, but students want to know the schedule so they can study and plan.
- The EE MS students request a handbook with a timeline for the process of completing the thesis option. They state that CS and CpE have this.
- The EE MS students request better transparency regarding administrative decisions that affect the student experience, mainly concerning course cancellations.
- The EE MS students request more application experiences (hardware and software) be integrated into courses.
- The EE MS students request better access to hardware and software lab rooms, and group study rooms. The EE staff state that students can get access passes. Many MS students are unaware of that option.
- Better communications (or a website) during the admission process: status, what to do next, how to select an advisor, list of advisors, and active research areas.
- Improvement of the process for creating and maintaining student course plans. First-year students state that during year one, the only record is their hand-written notes. Second-year students state that this is put on a form at the end of year one; however, that form is sometimes lost. An on-line system could be easier for all.

5. Faculty

The review team was able to meet with nine total full time faculty members. Seven were in the Electrical Engineering department. The review team also met with the Dean and Associate Dean who are faculty members in the departments of Computer Engineering/Computer Science and Mechanical Engineering, respectively. In the following, Faculty is used inclusively, meaning all of the people mentioned in this paragraph.

5.1. Enrollment and Hiring Strategy

The faculty were all aware of the declining enrollment and commented that the department is not able to hire new faculty due to the downward trend illustrated in the Self-Study Report. The larger data set in Figure 1 was presented, and the faculty were asked why the department was not able to hire during or subsequent to the peak in enrollment in the 2014-2016 timeframe. Faculty expressed various reasons, including a stalemate within the department on making decisions.

Faculty stated that a job search was opened in fall 2019 but was put on hold during the COVID-19 university shutdown that started in March 2020. The faculty were questioned about the reposting of this opening, since the other departments in the university had opened positions post COVID-19 shutdown. There was no clear understanding of the reason for not re-opening the search, but there was some discussion that the position may be on hold until the completion of the merger of Computer Engineering and Electrical Engineering programs into one department. The discussions made clear that only one faculty member has been hired and retained in approximately the last 20 years.

Many comments were made about the merger of the EE and CpE departments. Desired goals of the merger include increasing the faculty headcount, sharing the teaching and research load, and facilitating strategic decision making among the collective faculty. The faculty seem supportive of the plan. The review team feels that the combined department is a good strategic move, as long as both the CpE and EE faculty are strong. The lack of faculty hiring in areas specific to EE cannot continue. EE should be one of the cornerstones of the College of Engineering. The merger of the two departments does not include a clear plan to solve these systemic problems.

Various reasons were posited as contributors to decline in enrollment in EE (and other non-CS disciplines): the effects of COVID-19, the recent U.S. policies on immigration, lack of faculty hiring, inability to offer courses; and cancellation of required courses. The trend of engineering companies moving out of California was also proposed as a possible source of the decreased enrollment. Additionally, the faculty communicated that the University and College of Engineering do not perform public or community outreach to recruit graduate students from local engineering companies in an attempt to increase enrollment.

5.2. Class Availability

The importance of class availability was a common theme amongst faculty and students. The faculty is passionate that the department must provide students an opportunity to enroll in the classes that are required to graduate on-time. Many of the faculty shared examples of the administration attempting to cancel classes at the last minute, e.g., ~20-days before the start of the semester due to low enrollment (~8 students). However, when the class started 3-weeks later the enrollment was 24 students. It was expressed that the department had a plan to run "graduation critical" classes and cancel "non-critical" classes, however, this plan was not smoothly executed in conjunction with the Dean's office leading to students being forced to change their curricular plans.

5.3. Department Chair

The position of department chair appeared to be unstable within the department. In the past 7 years the department chair has changed 5 times and two of those times a department chair was appointed from outside the college of engineering. This is cause for concern when building a cohesive department with strong strategic goals. The review team thought that the acting Department Chair, Jidong Huang, is doing a very good job leading the department. The review team emphasizes that the college needs to appoint a very strong, long-term leader to this position especially with the merger of EE and CpE.

5.4. Qualifications

All faculty in the department are well qualified in terms of their academic and professional backgrounds.

5.5. Publications

Many of the faculty are research active in one or more ways: one has significant research funding with four papers in the last two years and another four in years 3-5; another faculty has seven papers in years 3-5; a third faculty has a new book edition within two years and a publication within the last five; yet another faculty appears to be active within ABET. Beyond that, three faculty have at least one publication in the last 2 years and two have no recent publications.

5.6. Grant Activity

Only one faculty has significant funding for research activity. A few faculty are actively seeking external funding grants. This agrees with the student comments that there are limited opportunities to work on funded research and projects within the department.

5.7. Research and Scholarly Activity

The faculty was in agreement that the department encourages research, but the current focus of the college is on teaching. Other science-based departments in the University are awarded

0.33WTUs per undergraduate student teaching independent study classes and/or mentoring a research, thesis, or project.   No clear WTU allotment is currently provided for mentoring undergraduate or graduate students. This may be the cause for faculty to shy away from mentoring student research projects. In many instances faculty confirmed that they were guiding students away from the thesis option because it was not properly accounted for in their workload accounting mechanism. Some of the faculty indicated that they had personally funded such research and projects because of the lack of funding.

5.8.   Graduate Comprehensive Exam

Some of the faculty members expressed concern with the written graduate comprehensive exam compared to the oral exam. The faculty liked the ability to be able to provide the students with a hint on the oral exam if the student got stuck, similar to a job interview format. The department moved away from the oral exam during the enrollment spike of 2014-2015 because logistically the faculty could not support that many oral exams. Due to the current lack of the oral option, some students may not have passed the written exam causing a remediation path and increasing the time to graduation compared to the oral exam. Table 6 of the Self-Study Report shows a decrease in 2-year graduation rates from 2015-2019, but other factors like course offerings need to be accounted for to understand this overall trend. During the COVID pandemic the department reverted back to the oral exam, and they seem to be having success with that method.

5.9.   Facilities

The lab facilities have been upgraded recently. The old-style analog oscilloscopes have been upgraded to digital versions and the lab power supplies were upgraded to versions that are more common in the industry. The equipment in the Senior Design Lab was purchased before 2008. This is not ideal for students in a field where technology is advancing rapidly. The computer systems in some of the classes are planned to be upgraded next year.

The college of engineering has hired an Academic Resource Manager as part of a multi-year plan for each department within engineering to forecast the equipment that it needs and follow the plan to spread the cost among engineering departments and budget for large lab purchases. This plan will help integrate upgrading equipment in a timely fashion.

One of the comments made by the students was that they wanted more access to the lab during off-hours (nights and weekends). The technicians stated that the students can request a pass to access the lab, but the Campus Police Department (PD) is required to be called to grant physical access to the lab after hours. This seems archaic for a modern college of engineering. RFID access tags may be a good solution; otherwise. students expressed that they would wait for the Campus PD for long periods of time before being granted access to the labs. Some students were not aware of the "pass" approach to gaining lab access. It was also stated that Graduate students are not observed in the lab very much. Both of these issues can be addressed in the short-term by having faculty communicate that these facilities are offered and how to access them.

5.10. Student Learning Outcomes

The program recently developed Student Learning Outcomes (SLO) for the graduate program. This is a step in the right direction for evaluating student performance over their educational progression. The faculty expressed that the SLO process is more work but captures measurable data that the department can use to evaluate trends and make the necessary corrections for continuous improvement.

Table 10 in the Self-Study Report defined four courses that fell below the 70% cutoff, and were recommended for improvement from the Fall semester of 2017. Table 11 shows that two of the courses went through the improvement process and had positive results in the Fall of 2018. The review team questioned the Dean and additional faculty to see if this process was being maintained and why only two of the four courses that were identified as 'Recommended for Improvement' were evaluated. The answer was that those courses were the focus at that time due to course availability. A continuous improvement process is only as good as the quality of the inputs and the willingness of the faculty to participate and adopt the process. In the future, it would be nice to have year-over-year data to be able to measure the program's effectiveness.

6. Students

The review team met with four existing graduate students and two recently graduated students for a total of six students. The students were very positive and proud of the program and university. Most of the students have struggled with their education due to the COVID pandemic leading to a lack of connection to the faculty and to other students both UG and graduate. In addition, the availability of classes offered to stay on track for graduation and the lack of research and/or thesis opportunities were the main issues that the students have with the program.

6.1. Graduate Advising

The graduate advising systems needs to be modernized. Many students complained that they attended a graduate advising session with a faculty and no documentation was provided to them and nothing was recorded. These students then received an automated email that the advising session had not taken place and that they were required to repeat the session. Many of the students had to repeat the advising process or bring their own notes back to the Administration to prove that the meeting took place. One student expressed that his/her study plan was lost 6 times by the university during their attendance in the graduate program. This is unacceptable for a technical degree program. This process should be computer based where the student and faculty member can access records of the advising results anytime.

6.2. Teaching

The students gave the faculty overall high marks on teaching. A few students shared that the soft skills of some of the faculty could be improved. It is important for faculty to reconnect with

the students now that students are coming back to campus after the COVID pandemic. Some of the students had issues with the faculty not answering their technical questions in class.
The students are also looking for more curriculum organization. The consensus was that faculty are not defining the exact subject material and deadlines in the syllabus for each week of instruction. The students want to plan out their workload and want to be able to read the chapters of the textbook in the week ahead of the class. Additionally, the dates for the midterm exams should be published toward the beginning of the semester so that students can create a study plan for success. In many instances the mid-term was announced a week before the exam.

6.3. Graduation Profile

Five out of the six students that were interviewed want to work in the industry after graduation, and one expressed interest in pursuing a PhD. Many students are working full-time while taking graduate classes. The department accommodates these students by offering classes in the evening, so the working engineering professionals can work during the day and attend class at night. More availability of lab space was discussed, and the recommendation is explained in Section 5.9.

The majority of the students were interested in participating in the project or thesis option but have been encouraged to take the Oral/Written Comprehensive Exam instead. One student said that they started the thesis option and it was transformed into a project by the faculty and administration so this student could graduate on time. One student stated a faculty declined to be their research advisor because the associated workload was not properly accounted for. This is very concerning for a Master's degree program.

6.4. Class Availability

Most of the students mirrored the same opinions of the faculty on class availability (Section 5.2). Many students have experienced class cancellations in the past 2-years. For many students, the overall cost of education is an important factor for choosing a program. Class cancellations increase the time to graduation and the overall cost of education.

7. Curriculum

The faculty stated that the EE graduate program was reorganized into a smaller number of focus areas to have a more sustainable number of required courses.

7.1. Areas of Concentration

Section II.B on page 10 of the Self-Study Report lists five (sic four) areas of specialization for the MS degree: Communication Systems and Signal Processing, Computer Engineering, Control Systems, and Electronics and Circuit Theory. These are closely aligned with the four areas of specialization for the BS degree listed in Section II.B on page 9 of the Self-Study Report. Section II.E on p. 17 of the Self-Study Report states that in Fall of 2021, the five areas

of MS specialization were reduced to two; 1) Communications, Signal Processing and Control Systems; and 2) Electronics, Circuits, VLSI and Computer Systems.

The areas have specialized elective courses that the student must take to become knowledgeable in that subject. Many Faculty members stated that due to low enrollment and because so many classes are being canceled, they have concerns both for attracting students to the program and for giving students a wide variety of specializations to choose from within Electrical Engineering.

Classes specializing in Systems Engineering were retired from the course list. Systems Engineering is perceived as a desirable area of concentration for many defense and automotive companies that are local to Southern California. Similarly, a faculty member specializing in Global Positioning Systems (GPS) is retiring at the end of this semester and there appears to be no plan for replacement. Losing critical subject matter experts in the department can be detrimental for the program in the long-term view.

7.2. Class Visit

The class visited was EGEE-537 Satellite Communications in classroom E-321. The classroom itself was clean and organized. Nine students attended the class and they seemed to be comfortable with the facilities. The class was being taught by displaying hand-written notes on an overhead projector. It is encouraged to incorporate more modern teaching methods and materials into the classroom to further engage students and take advantage of more recently developed technologies. Rather than projecting older and hard to read handwritten notes, technologies such as PowerPoint facilitate the maintenance of up-to-date teaching materials.