Graduate Program Review of EE and CS

The site visit for the Graduate Program Review of Electrical Engineering and Computer Science took place on April 3-4. It included meetings with many constituencies including students, faculty, staff and several levels of administration such as the leadership of the School and College. The final itinerary of the visit is reproduced as Appendix 1 of this report. The review team members express their appreciation for the thorough Graduate Self Study and the hospitality of our hosts, as well as their responsiveness and openness throughout the process.

Review Team:

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Overall Recommendation

The review team agrees that the EE/CS Program is functioning well and should be expanded.

Graduate Program

The School offers three graduate degrees: Ph.D., M.S. (with thesis) and M.Eng. (coursework only). In the past decade, the School expanded enrollment in the Ph.D. program, while reducing enrollment in the Masters programs.
The survey data and the conversations with current graduate students indicated a remarkably clear satisfaction with their graduate experience. The program appears to, in the perception of the students and alumni, to be meeting or exceeding all expectations. The graduate students and faculty are generally satisfied with the structure of the ECE and CS graduate programs. The committee did not have an opportunity to meet with any M.Eng. students and there seems to be minimal interaction between the M.Eng. students and the M.S. and Ph.D. students.

**Ph.D. Recruiting**

The faculty were generally satisfied with the quality of the Ph.D. students. As indicated in the *Self Study* (pp. 13-16), ECEE has a well-developed admissions process with key admissions decisions made by faculty within research groups, and all incoming students admitted to a research group. The quality of students is generally high and admission appears to be highly competitive – only 31 percent of the ECE applicants are admitted (on average) while 45 percent of the CS applicants are admitted.

Still, there was concern that the strongest applicants, even those awarded Fellowship offers, typically declined the offer to attend higher-ranked schools. Also, there was a general unease that the best candidates are not even applying to OSU. The percentage of admitted students who actually matriculate to the program appears to be low (37 percent for ECE, 29 percent for CS), with 62 and 71 percent of the students (ECE and CS respectively) refusing the offer to come to OSU. The faculty are developing initiatives to increase the perception and international awareness of the faculty and programs in the hope of attracting high quality faculty and students.

The School does have specific goals to increase the representation of women and under-represented minority students, with strategies to provide scholarships and to recruit through personal connections.

Admitting and recruiting Ph.D. students is delegated to research groups, rather than handled centrally. This has the benefit of incentivizing faculty to be involved in the process. Also, it’s an appropriate response to the fact that the student demand and selectivity varies across the research groups. On the other hand, groups that are small and less selective struggle to recruit strong students, possibly because their top prospects are less interested in committing to the research group in the first year than they would be in joining the school generally, without an early affiliation.

Recommendation: To recruit from a larger pool of candidates, and perhaps to bring in some star students, consider recruiting students who have non-traditional backgrounds. This might include students who majored in another area of math, science or engineering; also, it might include computing professionals who have been out of school for awhile. This will require creating an alternate path through the graduate programs – one that enables students to gain a solid foundation before progressing to graduate work.
**Strength of Curriculum**

The breadth and depth of ECE courses listed in the catalogue appears more than adequate to support the graduate programs in Electrical and Computer Engineering (M.S., M.Eng. and Ph.D.). The structure of the required breadth and depth courses for these programs seems appropriate and appears to be consistent with practice at peer institutions.

The CS curriculum is considerably weakened by the lack of faculty in some core areas. Examples include operating systems, compilers and cybersecurity. This is likely to hurt student recruitment into the graduate program, as well as their job prospects afterwards.

Recommendation: The long-term solution is to recruit faculty in these core areas of CS. In the short-term, consider re-assigning a few professors to develop and teach courses in these core areas, even if it is outside of their research areas. Also, consider hiring adjunct faculty for these core classes. For example, you might offer a compiler class taught by a visitor from Intel. To solve the logistical problem, the class might be taught using telepresence equipment, or it might be offered in a 1-week compressed form.

A general consensus of graduate students is that they struggle to find graduate courses they want to take. This is exacerbated by an unusually high coursework requirement, at least in CS.

Recommendation: Consider reducing the number of courses required of Ph.D. students. In CS, students are required to take two core courses, then three courses in each of three areas. Perhaps it would be better to require the two core courses, one course in each of three areas (for breadth), and three courses in the student’s research area (for depth). This reduces the course load from eleven to eight, which might help students, faculty and administrators.

Recommendation: In addition to meeting the coursework requirement, Ph.D. students are required to pass a qualifying exam as well. Commonly, a degree program requires either courses or a qualifying exam, but not both. Consider dropping one.

Recommendation: Students generally agreed that the “slash courses” (which enroll both undergraduates and graduate students) are ineffective. Some faculty assign different exercises and projects (and possibly exams) to the two groups of students, and this seems to improve the experience. Consider requiring this practice in slash classes.

Recommendation: There is some concern among the graduate students and faculty that not enough “pure” 500 and 600 level courses are offered on a regular basis. The students report some unpredictability in the schedule of how often, and in which quarters, specific graduate courses are offered. (This appears to be, at least in part, due to the need to cover teaching of the courses in the fast-growing undergraduate program.) Consider publishing course schedules, at least tentative ones, two years in advance so that graduate students can make plans.
Recommendation: Students receive little feedback from the Departments on their progress through the Ph.D. program. It seems that all students are reviewed annually – in CS by the faculty, and in ECE by the Director. Based on these reviews, consider providing regular feedback and guidance to the students.

**Enrichment Opportunities for Students**

Recommendation: About one-third of the Ph.D. students expressed interest in teaching an undergraduate class, serving as the instructor, not just as a TA. Consider offering this opportunity to selected students, not only for their benefit, but also to help meet the School’s teaching mission.

Recommendation: While some students felt they had enough contact with companies, others wanted more contact in order to explore internships and careers. These students expressed frustration with the School’s career fairs because they are focused on undergraduate students. Consider holding a separate career-fair event for graduate students or making the current fairs more explicitly graduate-student oriented.

Recommendation: Some graduate students requested more opportunities for professional development, such as grant writing workshops. Consider providing these opportunities within the School, College or University.

**Student Performance**

As indicated in the NAS survey, the GRE scores of the OSU students are competitive with student scores at peer institutions, as are the percentage of students with external fellowships.

As pointed out in the self-study, the graduate students have won a number of honors and awards. 83% of the surveyed alumni found jobs within 6 months after graduation. Most of them (82%) found employment directly related to their degree.

**Level and quality of infrastructure**

The EECS information technology support group was noted by many as being outstanding. The computing and teaching laboratory equipment appears to be first-rate with a regular equipment maintenance and replacement schedule. The ECE and CS faculty research labs and graduate student office space is well appointed, attractive and state-of-the-art. The Kelley building comfortably houses nearly all of the EECS personnel and laboratories (except for some teaching labs and the clean-room which are in nearby buildings). The open design of this building appears to be very effective in encouraging student and faculty interaction both formally and informally (e.g. coffee shop and atrium). If the projected aggressive growth rate is accomplished the facility will become very stressed in the next few years.
**Rankings and ratings**

The *Self Study* notes the U.S. News & World Report ranking of the CS program is number 63 (out of 94 programs) and the ECE program is number 72 (out of 134 programs). These rankings have not changed in the last 10 years. The program indicates some concern with these rankings in that they set a goal of improving these rankings.

Some insight as to what might be affecting these rankings and how these programs rank relative to the peer institutions (defined by OUS and OSU for such comparisons) can be obtained from the 2010 NAS survey of graduate programs. In the attached spreadsheet (OSU-ECS-ProgramReview.xlsx), we show the values of some comparators for the OSU programs and those of the peer institutions. The OSU program is competitive with a strong group of peer institutions in faculty grantmanship, support of students, gender equity, demographic tenure profile, and GRE scores. As the programs note, OSU has a smaller number of students and faculty than their peers, they published less and are less cited than their peers. (This issue might be addressed, in part, with senior faculty hires). The data on completion rates in the NAS survey do not agree with current evaluations.

The school is strong relative to its current peer group (top 50-75 EE, CE and CS programs) and has realistic aspirations for achieving many of the metrics of the top 25-50 peer group, especially in its research and graduate programs.

Rankings often do not reflect the true strength of the program but, instead, represent the lagging perception among peers. This requires very long timescales to change. Faculty recognition and size are generally also correlated with rankings. This suggests that recruiting high-profile faculty (IEEE and ACM Fellows and NAE members) to fill faculty vacancies can be especially effective. This often requires the use of endowed professorships and identifying donors for this must be started very early in the planning process. Another effective approach is to identify niches where EECS can build internationally recognized top programs. Leveraging the state's particular natural, human and infrastructure resources may be a starting point. The planned growth in faculty size will also contribute positively to improved rankings over time.

Recommendation: Consider a faculty recruiting strategy that leverages local strengths (e.g. natural resources, Intel), focuses on a few targeted interdisciplinary areas and pursues recruits in groups so that start-up equipment and facilities can be shared. Begin to raise funds now for future endowed faculty positions.

**Organizational Support**

The current leadership of the College and School seems to be very effective, and the leaders seem to have a shared vision. Moreover, the leadership is strongly supported by the faculty. The department administration takes pride in its academic and research programs and promotes them vigorously. The leadership appears to be very effective in procuring
resources and charting a direction for the school and its programs while the associate
director effectively manages the existing programs and facilities. There were very few
criticisms from the faculty about the overall leadership of the unit. A few of the faculty
have concerns about the growing administrative burden on the faculty for budgeting,
procurement, time reporting, etc.

The collegiality among the faculty seems extraordinarily high. Everyone is to be congratulated for helping to create and sustain that environment.

Recommendation: Currently it seems that all available funds – both current funds and anticipated funds – are earmarked for faculty growth. While this is clearly important, consider using a portion of the funds for administrative, instructional and other supporting activities.

Recommendation: The plan for faculty growth is very ambitious, and it carries some risks. One of the sources of funding for the growth is the INTO program. The leadership of the College and School should assess the reliability of the funding.

Recommendation: The EECS advisory board is large and engaged in the Program. Consider leveraging the Board for specific support of the program, in the form of cash, internships, funded research, scholarships, endowments and faculty support.

Recommendation: It seems that the ECE and CS programs are largely distinct. Building strength at the intersection of ECE and CS could leverage the successful integration of the two programs in one academic unit. Consider, for example, hiring joint faculty and conducting EECS-wide seminars of broad interest to graduate students and faculty.

**Mission of the Program in Relation to the University**

The *Self Study* of this graduate program provides clear evidence of alignment to the mission of the College of Engineering and to the three Signature Areas of Distinction in Phase II of the Strategic Plan for the University (advancing science of sustainable earth ecosystems, improving human health and wellness, and promoting economic growth and social progress). The ECEE faculty collaborate extensively with researchers across campus, and are nationally and internationally recognized for their outstanding research contributions. As such, the School enhances the reputation of the College of Engineering and OSU.
School of Electrical Engineering and Computer Science Graduate Council Program Review Site Visit

Wednesday, April 3rd
6:30 PM  Dinner at Del Alma, 136 SW Washington Ave STE 102, Corvallis, OR 97333
(Brenda McComb, Bruce Porter, Stephen Phillips, James Coakley, Walt Loveland)

Thursday, April 4th
7:30 AM  Breakfast at Hilton Garden Inn with School Head Terri Fiez
(Bruce Porter & Stephen Phillips)

8:15 - 9:00  Terri Fiez and Bella Bose (Kelley Engineering Center Boardroom, KEC 1126)

9:00 - 9:45  Dean of College of Engineering, Sandra Woods (KEC 1126)

9:45 —10:00  Break

10:00 - 10:45  EECS Graduate Committee (KEC 1126)
(Bella Bose, Prasad Tadepalli, Thinh Nguyen, Nicole Thompson)

10:45 - 11:45  EECS Faculty (KEC 1126)

11:45 - 12:30  Working Lunch for Review Panel (KEC 1126)

12:30 - 1:45  Facilities Tour (Dearborn, Kelley and Owen Labs, Graduate student offices)

1:45 - 3:00  Graduate Students (KEC 1007)

3:00 - 3:15  Break

3:15 - 4:00  Program Director (Terri Fiez and Bella Bose) (KEC 1126)

4:00 - 5:00  Executive Session (KEC 1126)
(Brenda McComb, Bruce Porter, Stephen Phillips, James Coakley, Walt Loveland)

6:30 PM  Dinner at Big River
(Bruce Porter, Stephen Phillips, Bella Bose, Terri Fiez, EECS Faculty)