June 18, 2019

TO:         James Henderson, Interim Provost
              William Karpus, Dean, Graduate School

FROM:      James P. Blanchard, Executive Associate Dean

RE:        Review of the MS and PhD Programs in Electrical Engineering

The Electrical Engineering (EE) Graduate Program review was completed by a review committee chaired by: Michael Arnold, Professor, Dept. of Materials Science & Engineering (Chair of the Program Review Committee); Greg Nellis, Professor, Dept. of Mechanical Engineering; Paul Terry, Professor, Dept. of Physics; and Shannon Stahl, Professor, Chemistry.

On May 15, 2019, the College of Engineering Academic Planning Council (APC) unanimously recommended for approval the attached review and self-study of the MS and PhD Programs in Electrical Engineering.

The review committee found the Electrical Engineering graduate programs are meeting the prescribed student learning objectives and leading to positive student outcomes. The curriculum, including the new introductory courses of ECE 610/611, support the programs’ student learning goals.

We have two recommendations that would align EE graduate programs with College priorities. First, the department should monitor and address the impact on the five year funding guarantee to ensure that it does not have a negative effect on the quality or quantity of admitted Ph.D. students and promotes a diverse student body. Second, the department should assess teaching assistant workloads to ensure that the workload is commensurate with the TA appointment. Addressing these two areas should help the department create an environment that fosters student learning.

On behalf of the College of Engineering, I accept the APC’s recommendation to approve this program review.

Attachments:  ECE Graduate Programs Self-Study Report for the 10-Year Review of the Electrical and Computer Engineering Graduate Program
cc:  Jocelyn Milner, APIR
Parmesh Ramanathan, Graduate School
Susan Hagness, Chair, Department of Electrical & Computer Engineering
Michael Arnold, Professor, Department of Materials Science & Engineering and Chair of the Program Review Committee
Laura Albert, Assistant Dean for Graduate Affairs, College of Engineering
Self-Study of Graduate Programs  
Electrical and Computer Engineering Department

This self-study is based on instructions from Vice Provost Jocelyn Milner to Dean Laura Albert and focuses on recent changes to the program, the student experience, and near future plans. It does not reproduce data from campus.

A. Introduction

The Electrical and Computer Engineering Department (ECE) has a long and distinguished history of graduate education. Master of Science and Doctor of Philosophy degrees have been awarded for the majority of the department’s 127-year history. There have been significant changes to the M.S. programs in the department in the past few years to increase opportunities for students seeking accelerated options for professional preparation.

Effective Fall 2019 ECE will offer four named option M.S. programs:

1. Signal Processing and Machine Learning (SPML), a 12 to 16 month course-only program designed to prepare students for rapid entry into advanced careers in industry. The first cohort of students entered the SPML program in Fall of 2017.
2. Professional, a 16-month course-only program designed for students that seek advanced training in any area of electrical and computer engineering. The Professional program was recently approved and will be available to new students Fall of 2019.
3. Power Engineering Online, a course-only program for working professionals seeking advanced degrees in power engineering. This program began in the early 1980s. Its success is driven by the reputation and deep industry connections of ECE in this area.
4. Research, the traditional research-based M.S. program for students interested in a research career.

The course-only M.S. program is being phased out and will not accept new students beginning in Fall 2019.

ECE has a robust Ph.D. program and also offers a doctoral minor.

The M.S. degree learning outcomes are:

1. Demonstrate a strong understanding of mathematical, scientific, and engineering principles in the field
2. Demonstrate an ability to formulate, analyze, and independently solve advanced engineering problems
3. Apply the relevant scientific and technological advancements, techniques, and engineering tools to address these problems
4. Recognize and apply principles of ethical and professional conduct

The Ph.D. degree learning outcomes are:

1. Demonstrate an extraordinary, deep understanding of mathematical, scientific, and engineering principles in the field
2. Demonstrate an ability to formulate, analyze, and independently solve advanced engineering problems
3. Apply the relevant scientific and technological advancements, techniques, and engineering tools to address these problems
4. Recognize and apply principles of ethical and professional conduct
5. Demonstrate an ability to synthesize knowledge from a subset of the biological, physical, and/or social sciences to help frame problems critical to the future of their discipline
6. Demonstrate an ability to conduct original research and communicate it to their peers

B. Administrative Structure

The relatively large size of the program (typically 300-400 students) results in a significant administrative burden. Historically the program was led by multiple faculty committees with staff support. However, this model was found less than optimal due to the increasing complexity of the program and graduate education in general. Also, growing complexity in the department chair’s role, increasing fund-raising/alumni relations, limits their time for day-to-day involvement in the graduate program. The department addressed these challenges in August of 2018 by creating an associate chair position to provide unified, department-chair level leadership and oversight of the ECE graduate program.

The Associate Chair for Graduate and Online Studies either chairs or works directly with the chairs of faculty committees relating to ECE graduate programs. The Graduate Recruiting, Admissions, and Fellowship Committee focuses on recruiting and admission of prospective students and stewards fellowship resources. The Graduate Curriculum Committee oversees all curriculum matters, including creation of named options and approval of course proposals. The Graduate Committee evaluates student petitions, organizes the Ph.D. qualifying exam and assesses Ph.D. student progress toward the degree.

The Associate Chair for Graduate and Online Studies also serves as the primary point of contact for student problem solving and advocacy.

A full-time Graduate Student Services Coordinator serves both prospective and current graduate students navigate the process of being admitted and ultimately satisfying graduation requirements. The ECE Payroll and Benefits Coordinator manages student appointments and assists graduate students manage their benefits. The ECE Communications Specialist helps with outward-facing content representing the program. The Department Administrator and Assistant Department Administrator support fiscal and other varied aspects of the graduate program.

C. Admissions

The ECE graduate student services coordinator is the first point of staff contact for prospective students. The Graduate Recruiting, Admissions, and Fellowship (GRAF) Committee makes admissions decisions for all M.S. programs. ECE is seeking to grow the new SPML and Professional named option M.S. degree programs to as many as 100 students total. These programs were actively marketed to ECE undergraduates during Fall 2018 as a realistic, one-year M.S. degree option, due to the ability to apply up to seven undergraduate credits to the 30 credits required. The Division of Continuing Studies is marketing these programs to external audiences. The Professional application did not go live until December 1, 2018 due to only receiving final approval in October, so growth in this program is likely to occur in future years. However, applications to SPML have been very robust. Our projection as of December 2018 is that we will admit 100 students for Fall 2019 with the expectation that about a third of admitted students will enroll.
We anticipate students that historically chose the discontinued course-only M.S. program will make up some of the desired growth in the SPML and Professional named options. However, a very significant portion of the desired growth is expected from new student populations. Hence our net graduate student population should increase. Program revenue will be used to support additional sections of classes and administrative services to ensure this population of students is successful.

The Power Engineering Online program has had relatively stable enrollment in the 25-30 student range. No significant changes are planned while the SPML and Professional programs are being launched and grown.

We have made significant changes to the Ph.D. admissions process Spring 2019. Ph.D. students will not be admitted without a financial support commitment from a research advisor. Coupling of admissions and financial support was implemented to improve our recruiting competitiveness, facilitate long-term funding guarantees for all Ph.D. students (see G. Funding), and ensure every incoming student has a clear advocate/advisor from their first day on campus. Qualified Ph.D. applicants that do not have a long-term funding guarantee from a faculty member will be admitted to the M.S. research program and waitlisted for the Ph.D. program. Some of these may choose to enter the M.S. research program in hopes of securing long-term funding for the Ph.D. before completing the M.S.

ECE hosts an open house each March for recruiting purposes. Historically this event has served to facilitate match making between students and faculty. The relatively late timing of this match-making event resulted in our financial offers to prospective students being later than those of our peers and put us at a competitive disadvantage recruiting the best students. Now that we have changed to coupling admissions and financial support decisions, the open house is designed to convince students that ECE is the right place for their graduate studies. We expect this change to both improve our recruiting success and student success in the Ph.D. program.

Data from the US News and World Report rankings of colleges of engineering indicate that our peer (top 20 colleges of engineering) institutions have 4-5 Ph.D. students per faculty member. This is consistent with current enrollment in ECE (~44 faculty, ~220 Ph.D. students), so we are seeking to maintain a stable level of Ph.D. students.

D. Program Information

The ECE Graduate Student Handbook is the definitive source for program requirements, processes, and information to help graduate student succeed. (A substantial portion of program information is also available in Guide (guide.wisc.edu).) Current and recent past handbooks are available on a web site in pdf format for students, faculty, and staff. The handbook underwent a major revision during Fall of 2018 to reflect the changing structure of the M.S. programs and to expand the types of information provided to students. For example, the newest version (published in January 2019) has added sections on professional development and health/wellness. The handbook is updated approximately annually to reflect changes in requirements and procedures.

E. Assessment
Multiple methods are employed to assess the ECE graduate program and improve student experience.

Every graduate student is assessed on the program learning outcomes prior to graduation. Ph.D. students are assessed on each learning outcome by their committee immediately following their final defense. M.S. research students are assessed by their research advisor in their last semester. Students in course-only M.S. degree programs (SPML, Professional, and course-only Power Engineering) choose a 700- or higher level ECE course with their advisor and the advisor insures that the instructor of the course fills out the assessment form. The assessment data are reviewed and discussed annually in a faculty meeting. Compliance with completing the assessment form was irregular in the past. However, after a concentrated effort to increase awareness of the importance of this process, every graduating student has been assessed in the most recent reporting period.

The department’s external advisory board has 20-30 members, typically from industry, and holds an annual three-day meeting in Madison to evaluate and advise the department. They are provided information about the state and direction of the department, meet with faculty and hold confidential discussion sessions with graduate students. One outcome of the visit is a series of recommendations. These are initially presented to the department’s leadership team orally and later in writing to the department and the dean. Their feedback has been very helpful in identifying issues with and strategic direction for the graduate program.

In Spring of 2019 the College of Engineering is rolling out an online tool for annual academic progress assessment of all degree seeking Ph.D. students. The academic progress assessment follows this process:

2. A review prepared by the faculty advisor to focus on an assessment of degree progress and student strengths and areas of growth. A copy of this review will be given to the student.
3. The student will have the opportunity to discuss this review in person with their faculty advisor.

The ECE Department wholeheartedly endorses this initiative and expects that a required annual progress assessment will be of great value to our Ph.D. students.

F. Diversity and Climate

The ECE Department has pursued multiple initiatives to foster an inclusive climate and community for all students. Each fall we hold a welcome and orientation event for all new students to introduce them to key faculty and staff and ease the transition to graduate school at UW-Madison. Several years ago, ECE created a new one-credit course (ECE610) that all graduate students are required to take in their first semester. They are introduced to faculty research areas, learn skills that will foster success in graduate school, and begin to form community through shared experience. A subsequent two-credit course (ECE611) is required for all Ph.D. students in their first spring semester. In ECE611 they continue to form community while learning key research and communication skills required to succeed as a Ph.D. student.
A student-led graduate student association (GSA) was formed about five years ago. The GSA initiates social activities and assists with various department events. For example, the GSA assisted with our fall new student welcome and recruiting events.

ECE adopted a parental leave policy to reduce academic and financial hardships for female graduate students during pregnancy, childbirth, and postpartum periods, and for any graduate student who is a new parent providing care for an infant.

ECE has actively sought out faculty role models for underrepresented groups in engineering. We have been very successful hiring female faculty, and as of Fall 2018 had one of the highest percentages of women faculty of any ECE department in the country. We are hopeful that our success recruiting women faculty will lead to a significant increase in women graduate students. We are also actively working on our outward facing messaging to create the impression of a welcoming climate for all underrepresented student groups.

The Department recently held a distinguished seminar series to celebrate its 125th anniversary. The series featured several prominent female and minority alumni as role models for current students.

The department hosted the WISELI workshop “Breaking the Bias Habit” on May 9, 2017 for faculty and staff. Approximately 75% of faculty and staff participated and learned how unconscious biases can create problematic climate. All faculty on search committees (we are currently leading or participating in six searches) are expected to participate in the WISELI “Searching for Excellence and Diversity” training.

The department is an active participant in College of Engineering supported programs designed to recruit and support targeted minority students. One program is the OPPS Conference held every November. College staff work with selected schools to identify students, match those students with the appropriate department, and then organize the two-day event. We are also active participants in the College of Engineering’s Graduate Engineering Research Scholars (GERS) program. GERS provides partial fellowship support for minority students. More importantly, GERS provides the supportive community that has been proven to help underrepresented students persist to graduation. Participation in minority recruiting and advising is widespread throughout the department – more than one third of our current faculty have made tangible contributions to advising or recruiting minority students.

The department’s priority is successful graduation of all students. Hence, we focus support systems that promote student success and on recruiting students that have the academic preparation for a rigorous graduate program. Our approach produces alumni that become leaders, role models, and that partner with us to identify/recruit new students. For example, Shakti Davis earned her ECE Ph.D. in 2006 as a GERS participant and was named “Most Promising Engineer or Scientist for 2010” at the U.S. Black Engineer of the Year Awards. Shakti regularly assists with our recruiting. She has been a keynote speaker at the OPPS Conference and during the Fall 2018 OPPS Conference spent an hour talking (via teleconference) with seven minority undergraduate students considering graduate studies in ECE. Juan Fernando Castillo is a current ECE Ph.D. student that travels each fall to the University of Texas El Paso (UTEP – a minority serving institution) to present the GERS program and ECE research to undergraduate students. As part of this initiative with UTEP, ECE invited and hosted
Professor Raymond Rumpf of UTEP in Madison to meet with our faculty to explore research and education collaborations. We are expecting to create an exchange where some of our undergraduates go to UTEP and UTEP undergraduates come to UW through the OPPS Conference and SURE program, and ultimately enroll in graduate studies. Daniel Cheverez is another former GERS program ECE Ph.D. that has sent his students (University of Puerto Rico) to UW.

Our approach of building reputation and strategic relationships requires substantial effort. Recruiting underrepresented students is a significant challenge due to many factors, including regional demographics and the relatively small number of minority undergraduates pursuing electrical engineering. However, the department is not content with the status quo and is committed to ongoing focus on recruiting and mentoring underrepresented graduate students. Some of our faculty are also working on increasing the pipeline of available students with outreach to elementary, middle, and high school students. Such efforts are critical even though they take a long time to make a difference at the graduate level.

G. Funding

ECE Department funding for graduate students is primarily based on a combination of teaching assistantships, research assistantships, and fellowships. With relatively few exceptions Ph.D. students are funded for the duration of their degrees. Many M.S. students are also funded. Historically some students had funding promised during the recruiting phase, while others chose to attend without up-front funding and attempted to secure funding once they arrived on campus. Ph.D. students arriving on campus without a research advising/funding commitment have sometimes experienced slow initial progress toward degree goals.

We instituted a major change to our funding policy for Ph.D. students in fall of 2018 to improve our recruiting competitiveness and ensure funding/advising uncertainty does not hinder student progress to degree. Beginning with the current recruiting cycle (Spring 2019) Ph.D. students will not be admitted to the program without a faculty commitment to provide long-term funding and advise the student. Hence all Ph.D. students matriculating in Fall 2019 will have both a long-term funding guarantee and an advisor committed to their success from the day they arrive on campus. Ph.D. students arriving with a B.S. degree receive a five-year funding guarantee, while those arriving with a M.S. degree receive a three-year guarantee. The support guarantee is at the 50% level and may consist of a combination of fellowship, research assistantship, teaching assistantship, and/or external funds such as NSF Fellowships. A significant fraction of our students are/will be supported through research assistantships associated with external grants secured by the advisor. If premature termination or nonrenewal of a grant causes loss of funds for a research assistant, the Ph.D. student will be shifted to a teaching assistant appointment until the advisor has secured funding for the student. If timing is such that a teaching assistantship is not possible, e.g., a mid-semester loss of funding, the student will be supported initially as a research assistant using departmental discretionary funding until it is practical to appoint them as a teaching assistant.

Income from our non-pooled tuition accelerated M.S. programs is being set aside to help support students that encounter unexpected loss of funding.
We are explaining the funding guarantee as part of our financial offer to admitted Ph.D. students as a reason why they should choose Wisconsin. Most of our peers do not have explicit funding guarantees and we believe our guarantee will be a recruiting advantage.

Students in the online M.S. Power Engineering program, and the accelerated M.S. SPML and Professional programs are not eligible for ECE Department financial support of any form. The students in the online program are not local and are typically employed in an industry position. Financial support for students in the SPML and Professional programs is inconsistent with the accelerated and terminal nature of these programs. Such students need to focus full time on their studies and not be distracted with teaching or research duties in order to finish in a 12- to 16-month time frame.

Students in the Research M.S. program are eligible for departmental financial support. This group has lower priority than Ph.D. students for fellowship and teaching assistantship funds. Teaching assistantships and research assistantships are awarded when there is a match between student expertise and departmental needs in teaching or faculty needs in research.

Grader positions are also available for graduate students and typically used by students that have not secured other departmental support. Project assistantships are also available on occasion, but do not constitute a significant source funding.

H. Retention and Time to Degree

The ECE Department has implemented multiple initiatives in the past few years to improve retention and reduce time to degree:

1. We have initiated a comprehensive orientation program. It begins with an orientation event at the start of each fall semester. Then all incoming students are required to take ECE610 (1 credit) in their first semester. ECE610 introduces students to faculty and other departmental resources and teaches skills they will need to be successful in graduate school. All Ph.D. students are required to take the follow up course, ECE611 (2 credits) in their second semester. ECE611 teaches students research skills, such as reading papers and writing proposals. We fully expect that this systematic on-boarding process will improve student success as the initial cohorts continue to progress through our program.

2. Expected timelines for Ph.D. program milestones (coursework, qualifying and preliminary examinations) are explicitly articulated in the Graduate Student Handbook. In spring 2018 the department added a requirement that the preliminary exam be completed within three semesters of achieving advanced graduate standing, i.e., passing the qualifying exam. This change was motivated by the observation that some students were delaying their preliminary exam until the majority of their research was complete, and then scheduling their final defense within several months of the preliminary exam.

3. All assistant professors are now encouraged in mentor meetings and written annual feedback to schedule their student’s preliminary examinations as soon as possible. This advice serves the dual purpose of helping their record for tenure and shifting the department culture in a way that reduces time to degree.

4. Long times to degree for Ph.D. students often correlate with difficulty finding a research advisor once students arrive on campus. Our new policy of requiring a funded advising
commitment prior to admission should improve retention and eliminate delays in time to degree due to student difficulty finding a research advisor.

5. A parental leave policy was recently adopted by the department to reduce academic and financial hardships for women and their partners who choose to have children during their graduate studies.

6. We have been actively monitoring and adapting our accelerated M.S. programs to ensure students complete the programs in an appropriate time frame. For example, SPML was initially set up to require completion within twelve months. However, experience with the first two cohorts of students showed that completing 30 graduate credits in twelve months is unrealistic for the professionally oriented, terminal M.S. students the program attracts, especially foreign students with additional ESL requirements. We modified the program requirements to reduce the number of credits required per semester consistent with a 16-month completion time frame (three semesters plus summer) and now advertise the program as a 12- to 16-month degree. UW-Madison undergrads that transfer six credits into the program can realistically complete the program in 12 months. We also requested and received approval from the Graduate School to count up to seven credits of undergraduate work completed at ABET-accredited undergraduate institutions in order to expand the set of students that can realistically complete all degree requirements in 12 months. Finally, we are in process of setting up and advising system that will efficiently serve the expected growing enrollment in the SPML program. This will involve a combination of written materials, mandatory group advising sessions, and individual consultations as needed.

7. We expect the annual assessment process being rolled out by the College of Engineering in Spring 2019 (see E. Assessment) will improve retention and reduce time to degree and are enthusiastically participating in this new program.

8. Finally, restructuring of the program leadership model – establishing the Associate Chair for Graduate and Online Studies – was also motivated by desires to improve retention and reduce time to degree. The Associate Chair is responsible for strategic analysis of the graduate program with the goal of improving student outcomes. Many examples of program changes are described elsewhere in this self-study. Another example of the Associate Chairs proactive activity is promoting awareness of mental health issues and resources. The Associate Chair periodically emails faculty and students concerning mental health issues, and has arranged for UHS counselors to lead a discussion at the February 2019 faculty meeting to raise awareness of the prevalence of mental health issues amongst the graduate student population and inform faculty how to better support mental health in our students. The Associate Chair is also the dedicated point of contact for advocacy and problem solving to help students with challenges that arise during their studies, including health related issues, or problems with faculty. Improved student support and timely resolution of problems is expected to improve retention and reduce time to degree.

I. Professional Development

The department’s graduate program supports professional development of ECE graduate students via a diverse range of mechanisms. Professional development beyond that provided by advisor mentoring has received increasing emphasis in the past several years. The Associate Chair now periodically emails all students to make them aware of the wide variety of campus resources that are available to them and encourages their use. The Associate Chair also communicates with
faculty periodically in both meetings and via email to remind them to encourage their students to undertake professional development activities. The latest version of the Graduate Student Handbook has a section devoted to professional development. The ECE610 and 611 courses required for all M.S. (610) and Ph.D. (610 and 611) students develop skills that not only help them succeed in their graduate careers, but also as professionals, such as engineering/technical communications, writing, ethics, and project management.

Recently we made a decision to provide teaching assistantship support of at least two semesters for any Ph.D. student that desires to obtain teaching experience. ECE offers the majority of its required undergraduate classes in active learning formats, many in WisCEL, so teaching assistants have the opportunity to apply research-proven best practices and obtain experience that prepares them to be innovative educators in their careers. We are currently investigating the possibility of requiring some sort of teaching experience of all Ph.D. students.

Most Ph.D. students are supported by their advisors to present their research at conferences and network with their external professional community. All dissertators are also eligible for department-administered travel funds to support conference travel.

A wide range of career outcomes are supported by the ECE graduate program. Ph.D. graduates typically establish careers in academia, private industry, or government laboratories. Our M.S. graduates typically take positions in industry, although some pursue Ph.D. or M.D. degrees. We recently responded to increasing industry need for engineers with advanced skills by creating the course-only SPML and Professional accelerated M.S. programs. The remarkable rate of technological advancement in the field has made it difficult to receive sufficient training for many industry positions in a four-year degree. Our accelerated M.S. programs are designed to provide students with these needed advanced skills in a short time frame. Our two programs are very new – the first cohort of SPML students graduated in August of 2018; we will accept the first Professional program students in Fall 2019.

Engineering Career Services provides extensive job-search support for our students, including: coordination of co-op and internship opportunities; hosting of career fairs and on-campus interviews; advice on resumes, cover letters, interviewing, and offers/negotiation skills.

J. Doctoral Minor

The Electrical Engineering Doctoral Minor continues to provide a valuable educational option for Ph.D. students in other departments. Our minor has served 113 students over the past 11 years (2007-2018). Mechanical Engineering (45 students), Computer Sciences (25 students) and Physics (22 students) make greatest use of this program. This is expected, as the disciplines of mechanical engineering, computer sciences, and physics have natural connections with electrical engineering.
Report for the 10-Year Review of the Electrical and Computer Engineering Graduate Program

May 1, 2019

Review Committee Members

- Michael Arnold, Professor, Materials Science and Engineering (Chair)
- Gregory Nellis, Professor, Mechanical Engineering
- Shannon Stahl, Professor, Chemistry (Graduate Faculty Executive Committee Representative)
- Paul Terry, Professor, Physics

Review Process

The committee was formed on March 9 and was charged to “analyze program quality and student learning, affirm ways that the program is working well, and implement improvements.” The charge asked the committee to “focus on evaluating the quality and function of the academic programs”, focusing on “academic programs and the student experience.” The committee began by reviewing the Electrical and Computer Engineering (ECE) Graduate Program Self-Study, in addition to the Graduate Handbook. The committee gathered additional information by:

- Performing one-on-one interviews with at least half of the Faculty in the department;
- Meeting as a committee with the ECE Administrators including the Chair (Prof. Susan Hagness), Graduate Associate Chair (Prof. Barry Van Veen), and Operations Associate Chair (Prof. John Gubner);
- Meeting as a committee with ECE Graduate Student Services Coordinators (Hannah Roberg and Daryl Harrison);
- Meeting as a committee with ECE Graduate Students; and,
- Reviewing ECE program statistics collected and published online by the Graduate School.

The Student Services Coordinators are College of Engineering staff who coordinate with ECE Graduate Students on matters including advising, policy, and degree progression. The two Coordinators, Hannah Roberg and Daryl Harrison, serve on-campus and off-campus online Graduate Students, respectively.

The Graduate Students who were interviewed were 3 Ph.D. students in their 2nd, 3rd, and 7th years of study, encompassing international versus domestic and gender diversity. The students were selected by the ECE Department because of their leadership roles in the ECE Graduate Student Association. The ECE Department did not provide students currently enrolled in a M.S. program; however, the 3 students who were interviewed did their best to provide a broad perspective representative of all students.
After reviewing the Self-Study, Handbook, and Graduate School data, the committee generated a detailed list of questions and topics that were used to guide discussion with the Administrators, Coordinators, Faculty, and Students. A total of 24 Faculty were interviewed including the Chair and Associate Chairs. The particular faculty members who were interviewed were determined by the ECE Department. The one-on-one interviews with Faculty were conducted for 20 minutes each over the course of April 17 to April 25, depending on the committee availability. The committee met with the Chair for 30 minutes, Graduate Associate Chair for 60 minutes, Operations Associate Chair for 30 minutes, Student Services Coordinators for 30 minutes, and Students for 30 minutes, on April 18.

Data

The ECE Department offers a Ph.D. program, a Research M.S. program, and 3 course-only M.S. programs including a Professional M.S. program (on-campus); an M.S. program specifically in Signal Processing and Machine Learning (on-campus); and an M.S. program specifically in Power Engineering (online). The Ph.D., Research M.S., and Powering Engineering M.S. programs have long histories whereas the Signal Processing and Machine Learning and Professional M.S. programs are relatively new (created in 2017 and 2019, respectively).

Size. The ECE Graduate Program is the largest Program in the Physical Sciences Division on campus with an enrollment of 359 students, averaged over the last ten years, compared to 315 in Computer Science and 318 in Chemistry. The ECE Ph.D. Program is the 2nd largest in the Physical Sciences Division with an average enrollment of 218 Ph.D. students (2nd only to Chemistry with 306 Ph.D. students). The ECE Department is attempting to increase the size of its M.S. Programs, in part to access new potential revenue streams associated with non-pooled tuition in the Named Option M.S. Programs.

Time to Completion (M.S.). The time to degree for an M.S. in ECE is on par with the typical time to degree in the Physical Sciences Division over the last 10 years. 48.1% and 81.0% of ECE students have completed M.S. degrees in ≤ 2 and ≤ 3 years, respectively, compared to 56.0% and 85.0%, respectively, in Physical Sciences.

Time to Completion (Ph.D.). The time to degree for a Ph.D. in ECE is marginally longer than the typical time to degree in the Physical Sciences Division over the last 10 years. 34.9% of ECE Ph.D. students leave with an M.S. or no degree, compared to the 30.7% in Physical Sciences. Of the remaining fraction that do complete their Ph.D. degree, 28.8% and 74.9% of ECE students have completed their Ph.D. degrees in ≤ 5 and ≤ 7 years, respectively, compared to 35.2% and 84.5%, respectively, in Physical Sciences. The ECE data are similar to data from ECE AAU Peer Institutions (characteristic time to Ph.D. degree of 5.24 years in the UW-Madison ECE Department compared to 5.10 years for AAU Peer Institution ECE Departments, averaged over the last five years).

Career Outcomes. The career outcomes for Ph.D. graduates in ECE are comparable to the rest of the Physical Sciences Division and are generally very good, with only 15% of Ph.D. graduates
not yet employed at the time of graduation in ECE compared to 18% in the Physical Sciences. Data for M.S. graduates were unavailable.

**Ph.D. Student Support.** In Fall of 2018, 69% (144 of 210) of ECE Ph.D. students were supported on Research Assistantships or by Fellowships (versus 60% in the Physical Sciences Division). However, 14.2% had no or insufficient support. The remainder of students were supported by Teaching and Project Assistantships (some in ECE; others outside of ECE).

**Faculty.** There are currently 42 tenure-track faculty in the ECE department (15 assistant, 2 associate, 25 full). 7/42 faculty are women. 4/17 assistant and associate faculty are women, showing improved gender diversity in recent hiring.

**Graduate Program Rankings.** #12 nationally in Computer Engineering. #16 nationally in Electrical Engineering. (2020 rankings; College of Engineering website)

**Staffing and Administration.** The Associate Chair for Graduate and Online Studies (currently Prof. Barry Van Veen) provides leadership and oversight of the graduate program and oversees faculty committees pertaining to (a) student recruiting, admission, and fellowship, (b) graduate curriculum, and (c) assessment of Ph.D. progress towards degree, including the Ph.D. qualifying exam. The on-campus Student Services Coordinator provides academic and sometimes personal advising to on-campus ECE graduate students (the vast majority of the ECE graduate students) and also interfaces with prospective graduate students. Other ECE staff contribute to payroll, benefits, and communications at both undergraduate and graduate levels.

**Interviews**

The one-on-one meetings with faculty and discussions with administrators, staff, and students were beneficial and provided first-hand insight into the Graduate Programs beyond the data and information provided by the ECE Department Self-Study. The tenor of all the interviews was highly positive. None of the interviewees identified major flaws. When prodded, faculty identified only minor criticisms, with the most prevalent concerns related to uncertainty about the impact of the department's new admissions policy, which requires faculty to provide a five-year funding commitment to incoming students, and to TA support. Aside from these minor criticisms, the interviewees indicated they were happy with the department leadership and had the opinion that the ECE Department and its Graduate Programs are headed in the right direction. The committee concurs with this assessment.

**Overall, the ECE Department’s Graduate Programs are healthy; their quality is excellent; the student outcomes are excellent; and student learning goals are being met. The Department should be commended for creating, maintaining, and continuously improving an outstanding Graduate experience.**

Below are summaries of particularly notable program strengths and concerns/challenges, followed by recommendations. For the most part, the concerns and challenges are of the type that
typically arise over time even in perfectly well run departments and/or because of budgeting constraints.

**Program Strengths**

- **Restructured Departmental Administration Resulting in Greater Commitment to Graduate Programs.** The creation of the Associate Chair for Graduate and Online Studies has been very effective in directing and coordinating faculty committees relating to ECE graduate programs. This restructuring has increased the number of faculty members involved in graduate student issues and enhanced their level of participation. The Associate Chair is viewed as strong and proactive, and his work is considered well coupled to similarly effective leadership provided by the Chair. The Associate Chair has also been an effective Department-level resource for graduate students. The restructuring of the Departmental Administration (along with other recent policy changes, see below) is evidence of the Department’s commitment to a Graduate Program that ensures excellent student outcomes, meets students’ learning goals, and creates a positive student experience.

- **Faculty Hiring that Promote a Better Student Experience.** The department had done an excellent job of hiring new faculty in recent years. The gender diversity among the faculty, which surpasses that of most ECE departments, is notable and should contribute to improved diversity among incoming students in the coming years and therefore a better student experience.

- **Favorable Career Outcomes for Students.** One of the most important student outcomes is job placement, and the department is performing very well in this area. Data show that the overwhelming majority (85%) of graduating Ph.D. students have lined up employment by the time of graduation. Job placement and career advancement were not worries shared by current students; on the contrary, placement and advancement opportunities were viewed optimistically. Faculty reported students are well sought after by industry and national laboratories, with graduates receiving multiple job offers with high bonuses (at least within some areas of ECE).

- **Improved Graduate Student Handbook.** The recently revised Graduate Student Handbook is rightly regarded as a significant improvement to the graduate program. It appreciably clarifies departmental organization, policies, and procedures, making them more transparent to students and ensuring that programmatic- and student learning- expectations are clearly defined. This information, including key details related to graduation benchmarks (e.g., qualifying and preliminary exams) will be of great value to the students and could even improve time to graduation. The revision of this handbook took considerable effort and is another example of the Department’s commitment to a Graduate Program that ensures excellent student outcomes, meets students’ learning goals, and creates a positive student experience.
• **Proactive Identification of “Orphan” Graduate Students.** Interviews with both faculty and students indicated that, in the past, graduate students who do not have advisers or funding might continue their program for years without making any real progress towards a Ph.D. The learning objectives of these “orphan” Ph.D. students were not being met without the necessary research experiences. Both students and faculty pointed to the new policy of requiring a five-year commitment at the time of admission as being a way to prevent this situation in the future. Students who “slip through the cracks” will be identified and provided alternate advisers and funding so that these students can meet their learning objectives. This should also decrease time to graduation.

• **Graduate Course Selection that Empowers Students to Meet Learning Goals.** Both faculty and students that were interviewed expressed their satisfaction with the graduate course offerings. The number of courses is felt to be sufficient to allow students to develop a course plan that prepares them for success and is interesting. The offering schedule is predictable and therefore does not cause delays in graduation. Scheduling challenges that arise are promptly addressed. Finally, the size of these courses is typically sufficiently small as to allow students access to the instructor and create a favorable learning environment. These characteristics will be challenged by the activation of the new Named Option M.S. programs; but, these observations suggest that there may be room for this expansion without negatively impacting student learning or the student experience.

• **ECE 610/611 Introductory Courses that Improve Student Outcomes.** The recent addition of required introductory courses for M.S. and Ph.D. students (ECE 610 and 611) has been a success on multiple levels. Students report the courses have improved community and cohesion among the graduate student population and therefore have improved the student experience. (The recent formation of a Graduate Student Association was cited as having a similarly important effect, providing more opportunity for graduate students to interact with a larger community.) Faculty appreciated the ECE 610 and 611 courses and their effectiveness at introducing students to research areas and groups and disseminating best practices for succeeding in graduate school. ECE 610 and 611 were also viewed by some faculty as effective means for identifying and recruiting promising M.S. students for potential future Ph.D. studies. Thus, the addition of these courses have facilitated interactions between students and faculty.

**Program Concerns and Challenges**

• **Insufficient Staff for Graduate Programs.** The large number of on-campus students in the Ph.D. and M.S. programs (300+ and growing) has placed an unrealistically large load on the singular staff member (the Graduate Student Services Coordinator for on-campus students) handling these student programs. The current staff member in this position has been extremely effective but has been overworked and is at risk of burnout. The department administrators and new Associate Chair for Graduate Studies have compelling ideas how to
improve the Graduate Program, student outcomes, and the student experience but lack staffing resources to execute these ideas. Overall, it is clear that administrative staff positions are insufficient for handling the workload under present and projected future conditions. Simply, the staffing is too small for a Graduate Program of this size.

- **Potential Unintended Effects of the Five-Year Funding Guarantee Policy.** A dramatic change in student recruitment policy has recently been implemented in response to the Graduate School’s requirement for a five-year funding guarantee. It is too early to gauge its effects, but it could have negative impacts on the Department. Student enrollment has the potential to drop significantly unless the admission procedure is modified to take into account anticipated declinations. Although implementation of five-year funding commitments to incoming Ph.D. students was largely seen by the faculty as a necessary step to improve student experience, there was concern and uncertainty about the details of how the policy has been and will be implemented by the department. Some faculty thought the policy would result in an improvement in recruiting and not affect faculty once the shock of the change wears off. But, others expressed concern, much of which is shared by this committee, about how this change will affect the long-term health of the program. One particular concern regards how the five-year guarantee is insured; there is sentiment that asking individual faculty members to assume all of the risk is not ideal (e.g., possible summer salary loss, future recruiting restrictions) and misses the possibility of leveraging risk by making the commitment collective across the faculty. Multiple faculty members conveyed reservations about hiring research assistants sight unseen with a five-year funding commitment, which inherently carries significant risk. At least one faculty member indicated that requiring a five-year funding commitment by specific faculty members and then not making TA backup funds easily available without stigma will have deleterious consequences. The worry of the committee is that the Department’s current policy could lead to fewer commitments by the faculty and therefore negatively impact Ph.D. student recruitment and the quality of the Ph.D. program as a whole (and therefore the student experience) -- if not addressed. Some faculty reported that the specific details of the policy have already resulted in faculty making fewer offers, as well as driving faculty to recruit graduate students from other departments.

- **Inequity in TA Workload (from student perspective).** Both student and faculty interviewees expressed concerns, mostly shared by the committee, regarding the level of TA appointment. First, the level of TA appointments does not correlate well with teaching workload. While the written agreement between the Department and TAs envisions times for task completion that fit within a certain appointment (e.g., 33%), graduate students regarded allotted times as insufficient to complete the tasks. This mismatch between workload and percentage appointment is a source of frustration for students, does not appear to be measured via surveys or other means, and has not been adjusted. Second, there is concern
that the level of TA appointment (typically 33% or less) is less than the levels of RA appointments and TA appointments in other departments.

- **Insufficient TA Support for Many Classes (from faculty perspective).** Interviewees very frequently expressed concerns about the need for more TA support in the department. It was noted that considerable TA support has been allocated to new “flipped” classrooms, while more traditional courses lacked adequate support to cover discussion sessions and office hours outside the classroom. As noted above, in many cases, TA workload and expectations by faculty surpassed that supported by their appointment. For example, relatively large courses (>50) are, in some cases, allocated only one shared TA, with a 1/6 or 1/12 appointment. The resulting burden on the faculty and TAs negatively impacts the educational experience of the students in these courses and the research productivity of the faculty and their groups and is therefore a drain on student outcomes both in the classroom and the research laboratory.

- **Long Term Plan for Providing Mental Health and Wellness Resources Needed.** The Graduate Associate Chair and Graduate Student Coordinator are very committed to supporting students for student wellness and mental health issues. However, there is concern that the effort required is not sustainable (e.g., could lead to burnout, or new people rotating through positions may be less well equipped). Also, students may not feel comfortable approaching these individuals (or their faculty advisors) as they may not be viewed as neutral. The College of Engineering mental health counselors are only available one day a week. The Department should consider and adopt long term plans to address these challenges because a substantial fraction of the graduate student body’s experiences and learning outcomes are affected by mental health and wellness issues.

- **Uneven Awareness by Faculty of Resources for Addressing Mental Health and Wellness Issues.** Most faculty indicated that the Department was more focused on student mental health than it had been previously (as evidenced by a recent visit of a UHS staff person to a ECE department meeting meeting). However, it was clear from the faculty interviews that understanding of the resources available for supporting mental health and wellness varied substantially among faculty and research groups. This perception was echoed by the graduate students. The confidence of faculty in their own ability to address mental health challenges also varied from faculty member to faculty member.

- **Diversity.** The Department is well connected to the GERS Program in the College of Engineering, and this is viewed as a successful and valuable resource. However, the ECE Department has less diversity in its graduate student population than it would like. The committee was concerned that the move towards a new 5-year funding guarantee policy for Ph.D. students could further negatively affect Ph.D. diversity. It is often the case that students from different socioeconomic backgrounds may not look as strong on paper as more traditional students. By forcing faculty to make student selection choices based largely on
their paper record, it might adversely affect their likelihood of bringing in a diverse graduate student pool. Several faculty indicated that a stronger connection to GERS might help mitigate this effect.

**Recommendations**

- **Create a New Graduate-Focused Staff Position.** An additional staff position should be authorized. The new staff member would assist the Associate Chair for Graduate and Online Studies, particularly in the area of programs for on-campus students, working with existing staff members to implement new ideas for improving and assessing student outcomes and learning goals.

- **Monitor and Address Impact of the Five-Year Funding Guarantee Policy.** The impact of the new five-year funding guarantee policy should be monitored by the department to ensure it does not have a negative effect on the quality and desired quantity of the Ph.D. student pool. Likely, the policy will need to be updated to ensure the policy promotes recruitment of the best students and promotes a diverse student body.

The department leadership and broader faculty should assess the impact of the new Ph.D. admissions policy in the near future, once data from the first year of implementation are clear. Such assessment should be continued for the foreseeable future to alleviate any negative impact this policy has on student recruitment by junior faculty, recruitment of underrepresented minorities, and other vulnerable groups. Efforts should be made to listen to and respond to concerns by faculty as the impact of this policy emerges, especially if negative effects become evident. The department leadership and faculty will be in the best position to devise effective measures to counter unintended consequences, but ideas include identifying better insurance policies to allow individual faculty to be aggressive in their recruitment of excellent students, while distributing the risk across the department. The department should fully leverage TA positions available inside and outside the department to allow for many more offers to be made than the number of positions directly available from existing faculty grants. New policies could be supported by the acquisition of good historical data summarizing sources of student funding, ratio of offers-to-acceptances, among other metrics to enable faculty to increase the number of offers beyond that allowed by the current policy. Specific policies should be implemented (1) to guarantee that junior faculty are given adequate “insurance” back-up to allow them to be aggressive in their recruiting during their probationary period and (2) to provide incentives for the recruitment of high-quality underrepresented minority students who may not be the primary targets of recruitment.

- **Assess and Update TA Workload and Appointment Percentage.** The ECE department should carry out a TA workload assessment to quantify workload on a course-by-course basis across the entire curriculum. The department is encouraged to adjust the TA workload for each course so that it is commensurate with the percentage of TA appointment, or vice versa.
Moreover, the department should consider raising the TA appointment percentage across the board so that it matches the RA appointment level and the TA appointment levels commonly offered by other departments -- in order to create a more equitable environment. One suggestion for quantifying TA workload is to require all TAs to keep accurate timesheets over a three week period to provide a snapshot of TA workload on a course-by-course basis. These actions promise to improve the experiences of students supported by TAs.

- **Increase Number of TA Positions and TA Budget.** More TA positions and an increased TA budget are needed to improve educational outcomes and faculty productivity. At the same time, a larger TA budget would allow the department to backstop individual faculty members’ five-year commitments to Ph.D. students in a way that is more natural and positive. Faculty should be encouraged to recruit aggressively with an understanding that it is expected that during some portion of their program, their graduate students will be expected to TA.

- **Expand Mental Wellness and Health Support and Awareness in a Sustainable Way.** Mental health training and advertisement of available resources (to both students and faculty) should be expanded. Inclusion of this content in 610/611 and graduate student orientation is a positive step that promises to be sustainable, but efforts should be made to ensure that more senior students, who may be more likely to encounter the need, are given and informed of these resources, as well. Possible steps could include (1) periodic emails from the Chair or Graduate Coordinator highlighting resources, (2) providing more opportunities for student networking and/or social interactions (e.g., led by the Graduate Student Association), and (3) training of faculty on issues related to mental health support for their students. Creating policies and best-practices that are sustainable and self-propagating in the long term are recommended. Regular UHS office hours with recurring advertisement to the students should be provided or another resource should be established to off-load some of the burden currently being carried by the Associate Chair and Graduate Coordinator.

**Other Observations by Committee:**

- **Maintaining Strength of ECE’s Part of a Successful Campus-Wide Program.** The fusion plasma program in ECE is highly successful (funding of $2M/year) and highly regarded nationally. It is one leg of a campus wide effort among three departments with a national ranking of 2 – 3. This is a graduate program issue because the plasma area is very successful in attracting numerous high quality students to UW-Madison across the three departments and in providing a uniquely rich graduate student environment. ECE is at risk for losing this program because its low priority in the department’s strategic plan may not result in replacements for retiring faculty.