Graduate Degree Programs in Electrical Engineering

The Pennsylvania State University
Department of Electrical Engineering
121 Electrical Engineering
University Park, PA 16802

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1. General Information

A. Contacts

- Department Head
  - **Dr. Madhavan Swaminathan, mus7249@psu.edu**

- Director of Graduate Studies
  - **Dr. John F. Doherty, jfd6@psu.edu**

- Graduate Program Coordinator
  - **Ms. Lisa M. Timko, lmg183@psu.edu**

- Director of Academic Affairs
  - **Prof. David Salvia, ads102@psu.edu**

- EE Safety Officer
  - **Mr. Adam Davis, amd233@psu.edu**

B. University Policies

This handbook includes a few of the general University policies that have specific relevance to The Department of Electrical Engineering (EE). It does not include all the policies that can affect your stay at Penn State see https://gradschool.psu.edu/graduate-education-policies . This handbook does not supersede any general policy of the University.

If you have specific questions, please feel free to contact the Graduate Program Coordinator in the Academic Affairs Office, 118 EE East.

C. Safety and Compliance

Any questions regarding safety should be directed to the EE Safety Officer.

EMERGENCIES-911
UNIVERSITY POLICE-863-1111
Campus Safety Information, https://www.police.psu.edu/campus-safety

In addition to safety issues, there are federally mandated compliance issues. Filing applications and obtaining approvals for the proposed work must precede any activities involving human subjects, vertebrate subjects, bio-hazardous materials, and radioactive materials. Details are available at https://research.psu.edu/

D. Scholarship and Research Integrity

Students are expected to commit themselves to the highest level of ethical conduct in their academic and research activities. All Electrical Engineering graduate students must complete the Scholarship and Research Integrity Requirements (SARI)

https://researchsupport.psu.edu/sari-events/ within their first year of graduate studies at Penn State (see Section II. C. Scholarship and Research Integrity (SARI) Requirement).

E. Graduate and Professional Student Association and Other Graduate Organizations

The Graduate and Professional Student Association (GPSA) https://gpsa.psu.edu/ provides numerous services and information to graduate students. The GPSA invites graduate students to participate in it's meetings and functions.

There are many other student organizations, including the Engineering Graduate Student Council, the student branch of IEEE, hobby, and sports clubs, etc. The GPSA is a good source of information.

The EE Graduate Student Advisory Committee (GSAC) provides representation of the graduate student body to the Director of Graduate Studies and the Department Head, who appoints this committee. The members also organize several events throughout the year to encourage interaction between graduate students in different research groups. The members of GSAC will be announced yearly.

II. Admission, Advising, SARI Requirements and Electrical Engineering Minors

A. Admission to Graduate Program

Students may be admitted to the MS program, to the PhD program after completing an MS program, or directly to the PhD program, bypassing the MS program. Applicants are expected to have a BS degree in Electrical Engineering. Expectational candidates from related fields are also welcome to apply. Only well prepared and highly competitive candidates should apply to enter the PhD program directly from BS program because they will be required to take the qualifying examinations within three semesters of entry into the program.

Applicants are required to complete the University's on-line application https://gradschool.psu.edu/admissions/how-to-apply which includes information specific to Electrical Engineering. They must provide official transcripts, letters of reference, a resume, and a personal statement of technical interests, goals, and expectations. International students whose first language is not English must submit TOEFL or IETLS score. It should be noted that students admitted to the graduate program who do not demonstrate satisfactory proficiency in English will be required to take additional English and or speech communication courses.

Students who intend to continue from the MS to the PhD program should apply for a change of degree at least three months prior to the transition. An updated personal statement, and a letter from the Department of Electrical Engineering faculty member who will serve as the student's PhD advisor, must accompany that request. Standards for entry to the PhD program are generally more rigorous than for the MS program. Satisfactory completion of the MS program does not guarantee admission to the PhD program.

B. Advising

Academic advising usually comes from the faculty member who supervises the student's research. Other members of the student's thesis or dissertation committee may also serve as advisors. A newly arriving MS student will be advised of the courses typically taken in the first semester for their given area of academic interests. The Director of Graduate Studies is available to consult and assist with difficult decisions, please see the Graduate Program Coordinator for assistance scheduling a meeting if you have a need. MS students are encouraged to meet with faculty members in their area of interest and strive to establish a faculty advisor by the end of the first semester.

C. Scholarship and Research Integrity (SARI) Requirement

Within the first year all EE graduate students are expected to complete the following activities, which must be completed to be eligible to take the Comprehensive Exam:

- Responsible Conduct of Research (RCR) training provided by the Collaborative Institutional Training Initiative (CITI) on-line https://citi.psu.edu/
- 3 hours of program specific training, discussion-based training available through EE colloquia. One EE 500 seminar each semester will be dedicated to the specific SARI training program. MS students must complete the EE 500 requirement by the same semester as the thesis defense or the EE 594 completion.
- 2 hours of discussion-based training facilitated at the University level. For detailed information please see the following website https://researchsupport.psu.edu/sari-events/

D. Electrical Engineering Minors for Students in Other Fields

The general requirements for a minor in Electrical Engineering shall be consistent with those of The Graduate School as stated in the Graduate Degree Programs Bulletin https://bulletins.psu.edu/graduate/

All graduate students desiring minors in Electrical Engineering shall formally register such minors with the graduate program as soon as the decision to enter such a minor has been made. At the time of registration, a program of study shall be formulated and any departures from these courses must have the approval of the Director of Graduate Studies and The Fox Graduate School. The Electrical Engineering MS minor requires 6 credits of 500-level Electrical Engineering courses. The PhD minor requires 15 credits of Electrical Engineering course with at least 12 of the 15 credits at the 500 level. You can find the Fox Graduate School GCAC-218 minor policy by visiting https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-218-minors

E. Area Table

Specialization Area[1]	EE Core Course[2]
Communications	560
Computer Vision and Pattern Recognition	560
Networking	560
Signal and Image Processing	560
Control Systems	580
Power and Energy Systems	586
Electro-Optics and Non-Linear Optics	524
Microwaves, Antennas, and Propagation	531
Remote Sensing and Space Systems	531
Circuits and Networks	510
Materials and Devices	542
VLSI	542

1. A student's primary and secondary specialization areas must not have the same core course.
2. The Specialization area core courses are intended to establish the fundamentals of the technical area.

III. MS Program in Electrical Engineering

The MS degree may fulfil different objectives. It can be a terminal degree, or it can focus towards preparing for a PhD. The MS degree can be research oriented, or it can emphasize graduate level course work. These various objectives are possible because of a choice between preparing an MS thesis or an MS paper. Course requirements are different for the two options. Additionally, the MS paper option can be completed either by working with a research advisor or via a special section of the EE 594 course.

Regardless of what option is chosen, several general requirements must be met. At least 50% of the total course credits required (excluding colloquium (EE500) and research credits) must be Electrical Engineering courses. The student's program shall count no more than 6 credits of individual study (EE596) and only members of The Department of Electrical Engineering graduate faculty may instruct Electrical Engineering individual studies courses. The undergraduate independent studies course (EE496) will not count toward the program's credit requirements. At most, 12 credits taken at the 400-level may be counted toward the degree requirements, though students can and often do take credits beyond degree requirements. Students may take relevant 400-level and 500-level technical courses from other graduate programs as long as they do not duplicate other course work, they have taken and do not exceed 50% of total course credits. All students must complete one credit colloquium (EE500) for two semesters. Degree requirements must be completed during a 6-year period.

Students who have deficiencies in the use of spoken or written English may be required to take courses in these topics in addition to the usual degree requirements.

Courses have been grouped into areas for the purpose of incorporating a breadth requirement into the MS program. These areas are:

- Communications, Computers, Networking, and Signal Processing
- Control and Power Systems
- Electromagnetics and Optics
- Electronics and Photonics

The most recent listing of 500-level courses by area can be found at the end of this booklet. It should be noted that some CSE courses are included in one of the areas. Not all courses are included in the listings. Only these listed courses are acceptable for the breadth requirement. If a student wishes to satisfy the breadth requirement by taking an Electrical Engineering special topics course (EE597), it must be approved by the Graduate Program Committee (by petition to the Committee) prior to scheduling.

A. Supervision and Advising

Students will be temporarily academically advised by the Director of Graduate Studies at the beginning of their first semester, unless they are offered a research assistantship at the time of their admission. The new MS students (standard paper or thesis option) will

consult with possible research supervisions to identify a research advisor with whom they will formulate plans, including courses to be taken and the choice between thesis and paper option. The research advisor may suggest and approve relevant technical courses from other closely related departments to be included in the MS program. The student and advisor will also identify other faculty members who will serve on the student committee. By the end of the second semester, the student must complete the "Option and Committee Membership Approval form" (can be found on our website https://www.eecs.psu.edu/forms/index.aspx) requesting the approval of the students committee, tentatively identifying the research topic, and choosing the thesis or paper option. The committee members and the Director of Graduate Studies ultimately sign the student's thesis or paper approval form.

Students completing the MS paper track via special section of the EE594 course will be advised by the faculty member conducting EE594 during the semester they are enrolled (see Section III.D).

B. MS Committee Specifications

A student's MS committee must have at least two members who are in the Department of Electrical Engineering graduate faculty and at least one member who is tenured or tenure-track in the Department of Electrical Engineering. The chairperson or one co-chairperson must be a Department of Electrical Engineering graduate faculty member and have a tenured/tenure-track appointment or joint, courtesy or dual title appointment in the Department of Electrical Engineering. An exception is that the committee can be chaired by a tenured/tenure-track faculty member from the Computer Science and Engineering department, in which case one committee member must be tenured/tenured-track in the Department of Electrical Engineering. All persons serving as chair or co-chair of a committee must be members of the Penn State graduate faculty. The committee may have additional members who are Penn State graduate faculty or who have professional appointments in the Department of Electrical Engineering or in a department related to the research topic. The committee may also have special members who have expertise in the MS candidate's research area and who would normally carry significant supervisory responsibilities. The special member should hold a PhD degree and must be approved by the EE Director of Graduate Studies. Members of the Penn State graduate faculty or persons not affiliated with Penn State who have expertise in the student's research may serve as Special Signatories who will read and approve the thesis or paper but are not required to attend the defense or presentation. The committee must be appointed by the end of the second semester in the program unless the student is completing the MS paper via the EE594 course option) see Section III.D). in this case, the committee is formed during the semester that the course is offered, and no later than the fourth semester in the MS program.

Any changes to the MS committee must be requested in writing (email) by the Chair of the committee to the Director of Graduate Studies, also copying the Graduate Program Coordinator.

C. Thesis Option

The degree requires 32 credits including 24 technical course credits (50% or more must be EE courses) with at least 15 credits at the 500-level, 2 colloquium credits (EE500), and 6 thesis credits identified as EE600 (thesis research). At least one course must be

taken at 500-level in two of the four previously mentioned areas to complete the breadth requirement. A list of 500-level courses by area is on the inside back cover of this booklet. EE597 courses must be approved by the Graduate Program Committee (by petition to the Committee) prior to scheduling, to be used to satisfy the breadth requirement.

Original research, usually requiring at least two semesters of work (6 credits), is expected for a thesis. The work should be an in-depth investigation intended to extend the state of the art in some specialty area. Mere application of some existing engineering technology is generally not sufficient.

At the beginning of the research, each student should obtain a "Thesis Guide" from the Thesis Office web page https://gradschool.psu.edu/academics/theses-and-dissertations . You can find the correct thesis formatting, along with deadlines, and submission procedures. Committee members may request periodic progress reports that may contain materials that will appear in the thesis. As work is satisfactorily completed, the grade of "R" is assigned to 600-level credits.

At least two weeks prior to the thesis defense, the completed thesis must be delivered to the committee members. Also, at this time, a defense date must be scheduled with the department's Graduate Program Coordinator who will assist with the room reservation. Students should complete the "Request to Schedule Thesis Defense" form found at https://www.eecs.psu.edu/forms/index.aspx . Students should take the MS Thesis Completion Report with them to their defense; members of the committee should only sign the form once they have agreed that the thesis
is completed. All committee members must attend the defense. Students submitting a thesis or dissertation through the Electronic Thesis and Dissertation Application will have their thesis and dissertation submission digitally signed by their committees via the eTD application. This capability allows a student to securely share their final document with the committee members and allows committee members the ability to review the document and give their approval electronically. When the Department Head is appointed as a committee member, the committee must have at least three members or two members and an approved signatory to satisfy the Thesis Office requirement for three signatures on the thesis.

D. Paper Option

The degree requires 32 credits including 27 technical course credits (50% or more must have an EE designation) with at least 18 at the 500 level, 2 colloquium credits, (EE500) and 3 credits of EE594 (paper research). At least one course must be taken at the 500-level in two of the previously mentioned four areas to complete the breadth requirement. A list of 500-level courses by area is at the end of this booklet. EE 597 courses must be approved by the Graduate Program Committee (by petition to the Committee) before scheduling, to be used to satisfy the breadth requirement.

The paper is intended to be a relatively short document compared to the thesis. Typically, it is the length of a manuscript prepared for submission to a professional conference. The work must be done while a student is enrolled in the MS program at Penn State. The paper must depict understanding of the application of the state of the

art. interdisciplinary activity is encouraged. The MS paper is to be authored only by the student, co-authored MS papers are not acceptable.

In conjunction with the paper, the student is required to make a presentation on the work. The student must schedule the paper presentation through the Graduate Program Staff who will make room reservations. Students should complete the "Request to Schedule MS Paper Presentation" form found at https://www.eecs.psu.edu/forms/index.aspx . Students should take the MS Paper Completion Report with them to their presentation; members of the committee should only sign the form once they have agreed that the paper is completed. All committee members must attend the presentation. The paper should be delivered to the committee members, and the presentation scheduled at least two weeks prior to the event. The student's advisor should turn in the completed MS completion report to the Graduate Program Staff.

The student must fulfill the 3-credit paper research requirement by registering for EE594. A grade of "R" is submitted if the work is satisfactory. When the paper is completed, all committee members and the Director of Graduate students will sign a paper completion report. The student must submit an electronic copy of the final paper to the Director of Graduate studies, copying the Graduate Staff Coordinator.

Students completing the paper culminating experience using the EE594 course option must complete the course no later than the fourth semester in the program. The faculty member conducting EE594 will serve as the Chair or Co-Chair of the student's MS paper committee. The second member of the committee will be a designated faculty member attending the paper presentation for the student.

E. Integrated Undergraduate Graduate MS Degree

Undergraduate honors students may apply to the EE Graduate Program to earn their MS degree simultaneously with the BS in EE. The following guidelines apply:

- Completion of an MS thesis with novel content, possibly building on Senior Honor's Theis, guided by EE graduate faculty member.
- Completion of the Senior Honor's Thesis by the end of the 8th semester.
- Submission of Senior Honor's Thesis proposal report during either students' 6th or 7th semester.
- Submission of an MS thesis plan at the time of submission of Senior Honor's Thesis.
- As many as twelve academic credits earned by the IUG Scholar may be applied to both undergraduate and graduate degree programs (double-counted).
- 50% or more of the courses proposed to count for both degrees must be at the 500 level.
- Thesis credits may not be double counted.
- Undergraduate honors requirements must be met by courses listed on your undergraduate transcript.
- When an IUG Scholar completes both the undergraduate and graduate degrees simultaneously, both degrees are in the same program, and where the program

head approves, the master's thesis may be submitted in lieu of the undergraduate honors thesis. Otherwise, two separate theses are required.

F. MS Time Limits

The Department of Electrical Engineering has established a six-year time limit for completion of the MS degree.

The MS thesis committee must be appointed by the end of the second semester.

The thesis defense or paper presentation must be scheduled, and a copy of the thesis or paper provided to all committee members at least two weeks prior to the scheduled date.

IV. PhD Program in Electrical Engineering

The doctoral student's goal will be to establish a reputation as research with a broad supporting base in laboratory and/or analytical techniques, and with experience in presenting original research results at conferences and in referred journals. The Department of Electrical Engineering welcomes highly qualified students with MS or MS degrees in Electrical Engineering, as well as in related engineering and science disciplines. The doctoral student becomes a PhD candidate after completion of several PhD progression to candidacy requirements and passing the Comprehensive Exam. These PhD progression to candidacy requirements, while centered in electrical engineering, are also intended to allow students with diverse backgrounds to efficiently move toward attaining their PhD degrees. To these ends, the student will pass the PhD Qualifying Exam (Section IV-B-2 of this booklet) to verify a sufficient base of study, be evaluated for English proficiency and presentation skills during a 15-20 minute technical presentation, develop a dissertation proposal to be presented at an oral comprehensive exam (Dissertation proposal exam), conduct the proposed research, and disseminate the results through the dissertation and related publications. As part of the program, the student will complete 30 technical course credits and 2 colloquium credits (EE500) beyond the BS degree, with at least 18 of these course credits at the 500 level (i.e., at most 12 credits may be 400 level). No more than 6 of these credits may be individual studies (EE596) and only members of the Department of Electrical Engineering graduate faculty may instruct Electrical Engineering individual studies courses. Courses not in Electrical Engineering require the approval of the research supervisor. An undergraduate individual study course (EE496) will not count toward program credit requirements. A PhD student with graduate credits from other institutions may request the approval of the Director of Graduate Studies to count related technical courses credits toward the PhD credit requirements. A maximum of 24 such credits may be counted. Students with MS degrees entering the PhD program will be required to take a minimum of 6 course credits. The exact number of credits counted, and the requirements and restrictions on the course work will be determined after consultation with the Director of Graduate Studies at the beginning of the student's program enrollment. It should be noted that the student must always satisfy the core course (6 credit) eligibility requirement for the Comprehensive Exam.

A. Advisor and Committee

The faculty member who recommended the student for admission will serve as the student's advisor. The advisor is expected to be the research supervisor when the student is supported as a research assistant. Students must have a research advisor before they can be registered for the PhD qualifying exam. The research advisor must be documented no later than the end of the second semester after admission as a PhD student and must form a doctoral committee no later than the end of the semester after the student has passed the PhD Qualifying Exam. The committee will consist of at least three members of the Department of Electrical Engineering graduate faculty and one non-Electrical Engineering graduate faculty member. At least two members must be tenured/tenure-track in the Department of Electrical Engineering. The chairperson or one co-chairperson of the committee must be a Department of Electrical Engineering graduate faculty member and have a tenured/tenure-track appointment, or joint, courtesy or dual title appointment in the Department of Electrical Engineering. The committee can be chaired by a tenured/tenure-track faculty member from Computer

Science and Engineering department, in which case at least one committee member must be tenured/tenure-track in the Department of Electrical Engineering. Either the chairperson or one of the co-chairpersons will normally be the primary research supervisor. In addition to the chairperson, at least two members of the doctoral committee should have a specific interest in the dissertation or in a closely related area. Additional graduate faculty and/or special members (as defined in the Graduate Degree Programs Bulletin and approved by the Dean of the Fox Graduate School may by appointed to the committee. The committee must be recommended by the Department and appointed by the Dean of The Fox Graduate School. The student must request the appointment of the committee through the Graduate Program Coordinator. The student should send the list of committee members' names along with the faculty member user ID and indicate the role each person will serve on the committee to the Graduate Program Coordinator. The Graduate Program Coordinator will then create an Adobe form that all members must sign, after all members have signed and the Director of Graduate Studies approves the committee, the doctoral committee form will be sent to the Fox Graduate School for approval. Please note that this process can take some time, so please plan accordingly.

If a student wishes to change the advisor, a written request must be submitted to the Director of Graduate Studies for approval. This request must be reviewed and approved by the new advisor and the current advisor before it is submitted to the Fox Graduate School for review and approval. Please note that a new doctoral committee form will also need to be completed.

Any changes to the PhD committee must be requested in writing (email) by the Chair of the committee to the Director of Graduate Studies, also copying the Graduate Program Coordinator.

PhD Committee Worksheet ('1' == yes; blank == no; Shaded cell have to be == '1')

Role	Name	EE Grad Faculty	Penn State Grad Faculty	EE Tenure Track	EE Joint, Courtesy, Dual Title	
*Chair						<-- need at least one of these two == '1'
Co-Chair						
CSE tenure track == EE tenure track for Chair						
*Adviser						<-- need at least one of these two == '1'
Co-Adviser						
Do not count if the same person as the Chair						
Major Program Member						
Major Program Member						
Major Program Member						
*Outside Field Member						
*Outside Unit Member						
Must not be in School of EECS.						
Special Member						
Sum the column						
		Need at least 3 for this column		Need at least 2 for this column		

Worksheet Example 1

Role	Name	EE Grad Faculty	Penn State Grad Faculty	EE Tenure Track	EE Joint, Courtesy, Dual Title	
*Chair	**George Kesidis**	1		1	1	<-- need at least one of these two == '1'
Co-Chair						
CSE tenure track == EE tenure track for Chair						
*Adviser	**George Kesidis**					<-- need at least one of these two == '1'
Co-Adviser						
Do not count if the same person as the Chair						
Major Program Member	**John Doherty**	1		1		
Major Program Member	**Sawyer Campbell**	1			1	
Major Program Member						
*Outside Field Member	**Sharon Huang**		1			
	IST					
*Outside Unit Member	**Sharon Huang**		1			
Must not be in School of EECS.						
Special Member						
Sum the column		3		2		
		Need at least 3 for this column		Need at least 2 for this column		

Worksheet Example 2

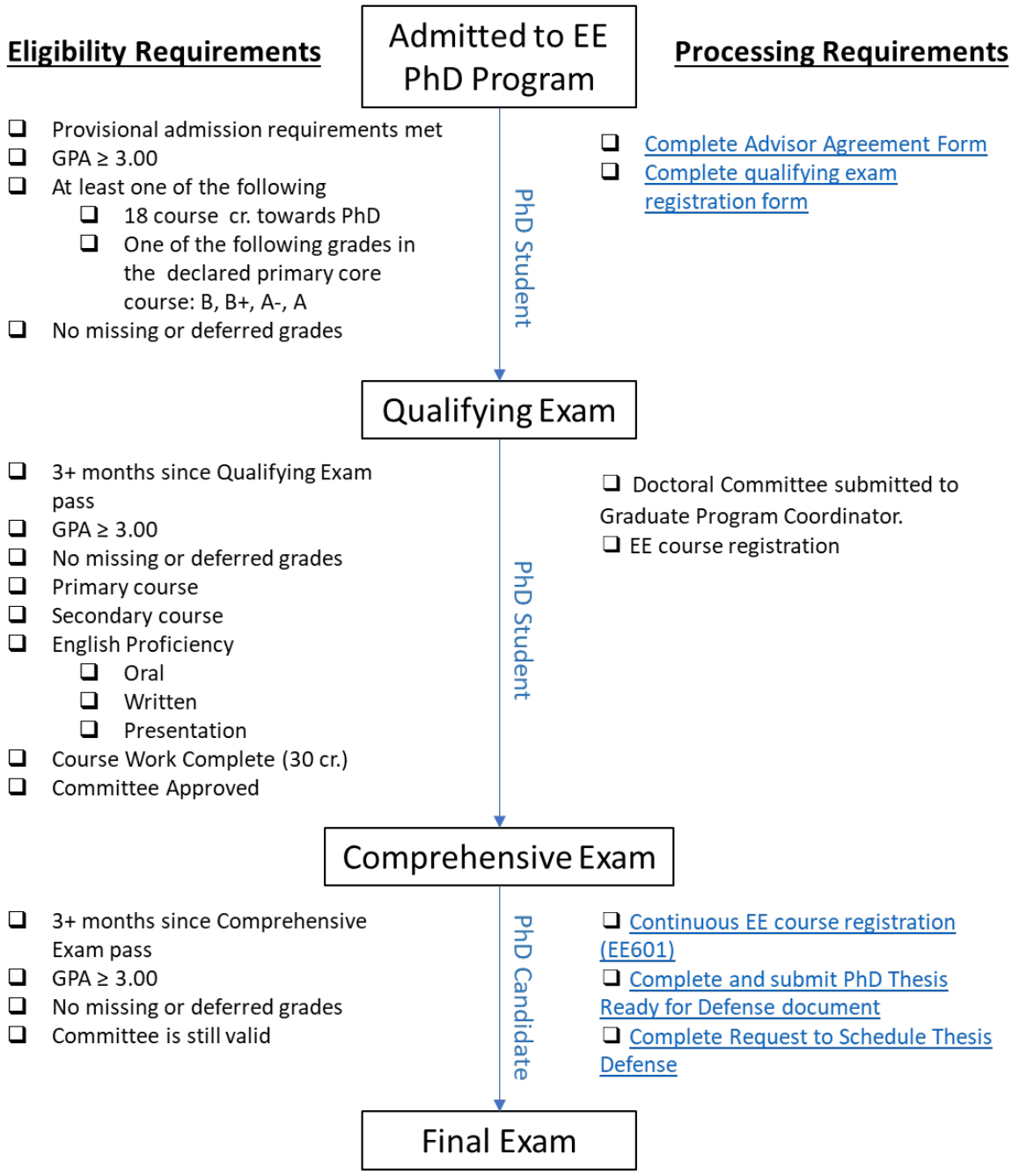
Role	Name	EE Grad Faculty	Penn State Grad Faculty	EE Tenure Track	EE Joint, Courtesy, Dual Title	
*Chair	**Suzanne Mohney**	1			1	<-- need at least one of these two == '1'
Co-Chair						
CSE tenure track == EE tenure track for Chair						
*Adviser	**Suzanne Mohney**					<-- need at least one of these two == '1'
Co-Adviser						
Do not count if the same person as the Chair						
Major Program Member	**Thomas Jackson**	1		1		
Major Program Member	**Aida Ebrahimi**	1		1		
Major Program Member	**George Kesidis**	1			1	
*Outside Field Member	**Christine Keating**		1			
	Chemistry					
*Outside Unit Member	**Christine Keating**		1			
Must not be in School of EECS.						
Special Member						
Sum the column		4		2		
		Need at least 3 for this column		Need at least 2 for this column		

B. PhD Progression

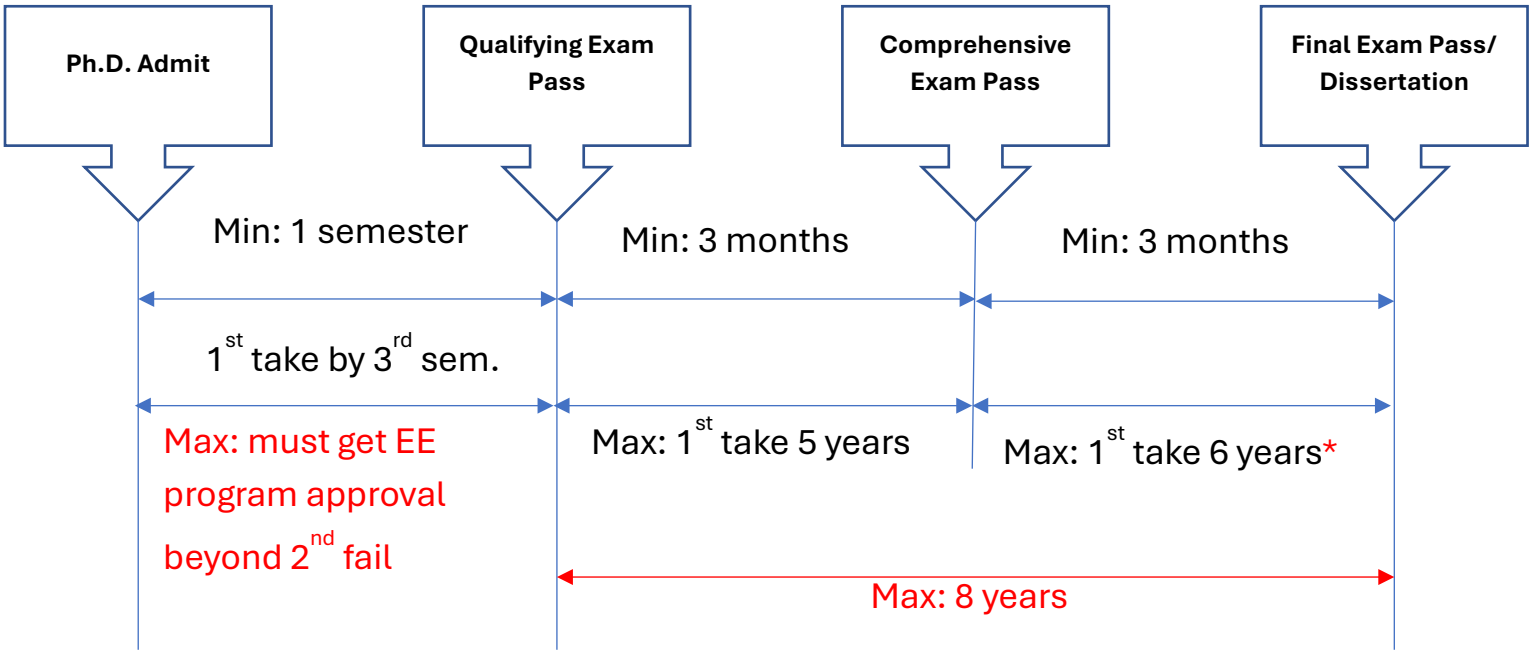
Procedures

There are several significant milestones along with progression from being an admitted PhD student to the conferral of the PhD degree. There are three major evaluative exams that the successful PhD student must pass: Qualifying Exam, Comprehensive Exam, and Final Oral Exam, sequentially in that order.

PhD Progression Significant Milestones



PhD Progression Timeline



*Must pass another Comprehensive Exam if greater than 6 years.

PhD Qualifying Exam Eligibility Requirements:

- Must be registered
- Must have a GPA of at least 3.0
- No missing or deferred grades
- Must have met all provisional admission requirements
- In addition, the student must satisfy one of the following criteria (a) earned at least 18 credits in courses eligible to be counted towards the degree, (b) A grade of B, or better, in the designated core course associated with the student's primary area of specialization chosen by the advisor from Section II.E.

Qualifying Exam Format

1. IMPORTANT. The student's advisor must initiate the student's registration for the Qualifying Exam. The student may not register for the exam.
2. The student's advisor selects the primary specialization area from Section II.E. This also selects the primary core course, which may be used to determine the student's eligibility to take the Qualifying Exam (see above).
3. The student's advisor selects one published peer-reviewed paper for the student and submits it to the Qualifying Exam Committee; this indicates that the advisor has agreed that the student has permission to take the qualifying exam.

4. The exam team will consist of three faculty members; at least one faculty member will be in the student's technical area.
5. The student prepares and delivers a 20-minute (uninterrupted) slide presentation. The student should provide a discussion on the motivation, contributions, and impact of the paper that speaks to the creation and retention of knowledge and the advancement of the state of the art. The presentation should discuss the motivation for the work, the methods used, and the contributions of the paper. The student should also provide a reflection on what they learned by preparing for the exam. It is expected that the advisor will provide guidance in the student's preparation for the exam.
6. The total length of the exam is expected to be no more than 60 minutes including the wrap-up discussion. Questions from the examination team will generally be broad in scope and focus on the student's perspectives on conducting research and the student's critical thinking skills. Technical questions may be pursued if research domain knowledge deficiencies are suspected.
7. Each member will determine if a student "passes" or "fails." The student passes if a majority of the exam team votes to pass the student.

Timeline of Qualifying Exam

1. The exam will take place during the 4th week of each semester. Each examinee will have their exam date determined and communicated on or before the Friday of the 3rd week of each semester.
2. Results will be provided to the students by the 6th week of the semester.

Comprehensive Exam

Admission as a PhD student does not imply admission to the PhD Candidacy, which is granted only after a student passes the Comprehensive Exam. The Comprehensive Exam should be scheduled within a year of completion of all the required coursework, but it must be scheduled no later than 5 years following the passing of the Qualifying Exam.

<u>Eligibility Requirements</u>

- Must pass the Qualifying Exam
- Must have an approved PhD committee
- Must be registered
- Must have a GPA of at least 3.00
- No missing or deferred grades
- Must complete coursework (30 credits minimum)
- Must complete the following PhD progression to candidacy requirements:
    - Complete the Communication and Language Competence requirements (described below)
    - Successful completion of the designated core course in the primary area of specialization (a grade of B or better is required) – the area table is in Section II-E of this handbook.

- Successful completion of the designated core course in the secondary area of specialization (a grade of B or better is required) – the area table is in Section II-E of this handbook.
- Successful completion of SARI requirements
- Successful completion of the Qualifying Exam

Please note: most core courses are offered fall semester only; core courses taken at Penn State Harrisburg can be used to satisfy the PhD candidacy requirements.

The PhD student will take the comprehensive exam following completion of all course work required for the PhD (30 course credits minimum past the BS degree) and submission of the PhD proposal to the PhD committee members. The comprehensive examination may be held fully in-person, fully remote, or hybrid with some individuals participating in-person, while others participate remotely. Student preference for delivery mode should be strongly considered, but the student and advisor must agree with the mode. If the student and advisor cannot agree on the mode, the Graduate Program Head will make the final decision. Either the student or advisor can appeal against the decision of the Graduate Program Head to the Fox Graduate School.

The student will be responsible for coordinating a time for the exam that is acceptable to the committee. The student must complete the PhD request to schedule exam form and the PhD ready to defend form. The forms must be turned into the Graduate Program Coordinator to schedule the exam at least three weeks prior to the exam date. Forms can be found at https://www.eecs.psu.edu/forms/index.aspx . The dissertation proposal must also be submitted to the doctoral committee at that time. The PhD Committee Chair is responsible for coordinating and executing the remote component of the exam if applicable. All members of the committee must participate in the comprehensive exam during the scheduled time.

The Director of Graduate Studies will request that the Dean of The Fox Graduate School schedule the exam. The exam may be canceled if the proposal is not delivered to committee members at least three weeks prior to the exam date.

A dissertation proposal is required for the comprehensive exam. Though the nature of this proposal is under the jurisdiction of the doctoral committee, it is recommended that it should be prepared by adhering to the guidelines provided for research proposals submitted to such agencies as the National Science Foundation. That would require limiting the size of the main body of the proposal to the equivalent of fifteen single-spaced pages of text. This proposal should contain, as a minimum, the background and motivation for the research being undertaken, the specific problems to be tackled, and the approach as well as methods to be adopted for attempting the solution together with a summary of any preliminary results. Any additional material that does not belong to the core of the proposal but provides either justification of the proposed scheme or documentation of preliminary efforts could be included in an appendix.

The Graduate Program Coordinator will submit this request (signed by the Director of Graduate Studies) for scheduling the comprehensive exam only after:

- The committee has been appointed;
- The committee members have approved the date;
- All conditions stipulated after the qualifying exam have been met;
- All required English courses have been completed

The comprehensive exam will consist of three parts:

- The oral presentation of the dissertation proposal (including a discussion of the importance of the problem and the current state-of-the-art in related areas);
- The oral examination by the doctoral committee which will seek to determine the student's qualifications to pursue the proposed dissertation research, i.e., the preparation in the appropriate specialized and related areas, and the student's general background and knowledge;
- The committee's verbal evaluation of the student's progress and recommendations for any additional course work and research.

Upon completion of the comprehensive examination, each committee member will be required to submit their assessment electronically directly to the Fox Graduate School. The Fox Graduate School requires a favorable vote of at least two-thirds of the committee to pass this examination.

Students who have passed the comprehensive exam and who have met the residency requirements must register for EE601 in subsequent semesters. Such a student may take 3 additional credits with EE601 for an additional charge; however, it must first be approved by their advisor.

C. Communication and Language Competence

The PhD student shall demonstrate competence in the use of English Language for purposes of both written and oral communication. During the first year, students whose first language is not English must demonstrate speaking and listening skills. The student must be able to communicate technical material in a clear, concise, and well-organized manner. The research advisor or the doctoral committee may require that the student take formal courses in technical writing, speech, etc., if it is not determined that the communication skills are inadequate. There will be various communication experiences throughout the program, starting at the beginning of the first semester at Penn State University.

1. Writing Requirements

PhD students who have passed the PhD Qualifying Exam must take a test of written English. This test is given during the spring semester every year and is scheduled by the EE Department. Non-native English speakers who have successfully completed ESL 116G or native English speakers who have successfully completed a technical writing course (ENGL202C at Penn State or an equivalent

course at another institution) at another institution will be exempt from this test. Students who fail the test will be required to take ESL116G and be required to receive a B or better in the course.

Students are expected to gain further writing experience by preparing research reports, conference papers and referred journal articles as they report on their original findings before their final defense. The doctoral committee is expected to review and critically evaluate any of the student's written work, including the dissertation proposal, interim reports, and manuscripts.

The dissertation is to meet the standards set forth by The Fox Graduate School and is to be evaluated by the doctoral committee for the quality of the writing as well as technical content. At the beginning of the research, each student should access the Thesis and Dissertation guide https://gradschool.psu.edu/academics/theses-and-dissertations insuring that the written or graphical materials generated from time to time can be in the format acceptable to The Fox Graduate School.

2. **Oral and Presentation Requirements**
   All international PhD students will be interviewed at the beginning of their study for evaluation of oral English skills. Those who have deficiencies will be required to take ESL (English as a second language) courses during their first year (preferably their first semester).

   Presentation skills of all PhD students must be evaluated before scheduling the Comprehensive Exam. Each student will make an approximately 20-minute presentation on a technical topic to a technical group that includes the research advisor, e.g., students and faculty. The presentation will be coordinated by the research advisor and should take place no later than the first semester after passing the qualifying exam and must be completed before scheduling the Comprehensive Exam. Students found to have deficiencies in presentation skills must pass an English course to develop these skills to satisfy the requirement.

   In addition, the student is encouraged to travel to conferences to make oral presentations of his/her work.

D. Final Oral Exam

Eligibility Requirements

- Must pass the Comprehensive Exam
- Must have an approved PhD committee
- Must be registered
- Must have a GPA of at least 3.00
- No missing or deferred grades

The final oral exam must be completed within eight years after the date of successful completion of the Qualifying Exam, not including approved leaves of absences, and within 6 years of passing the comprehensive exam. A minimum of three months must have elapsed since passing the comprehensive exam.

Final oral examinations may be held fully in-person, fully remote, or hybrid with some individuals participating in-person while others participating remotely. Student preference for delivery mode should be strongly considered, but the student and advisor must agree to the mode. If the student and advisor cannot agree on the mode, the Graduate Program Head will make the final decision. Either the student or advisor can appeal against the decision of the Graduate Program Head to The Fox Graduate School.

At least 3 weeks before the Final Oral Exam, the student must complete the required forms; PhD Ready to Defend, and PhD request to schedule final exam to officially schedule the final oral exam. The PhD Ready to Defend form is verification that the student is ready to defend and requires the advisor's signature, and that the dissertation is ready to be distributed to the other committee members and ready to be defended. This form must be directly returned to the Graduate Program Coordinator by the Committee Chair. The Graduate Program Coordinator will schedule a room for the exam. The PhD Committee Chair is responsible for coordinating and executing the remote component of the exam if applicable. The remote access information must be given to the Graduate Program Coordinator before the exam can be scheduled, so that the exam can be properly announced to the public.

At least 3 weeks before the Final Oral Exam, the student will distribute copies of the dissertation to the committee member. The exam may be cancelled if documents are not delivered to committee members at least three weeks prior to the exam date. The Graduate Program Coordinator will verify that all requirements have been met and will obtain the Director of Graduate Studies signature and send the request to The Fox Graduate School.

The Fox Graduate School sends the Final Oral Exam report from the Graduate Program Coordinator indicating that the exam has been officially scheduled. This examination, open to the public, relates in large measure to the dissertation but may cover the entire field of study. The doctoral committee determines the exact examination procedure. All members of the committee must be in attendance for the entire exam. Upon completion of the final oral examination, each committee member must submit their assessment electronically to the Fox Graduate School. A favorable vote of at least two-thirds of the members of the committee is required to pass the final oral examination. If the student fails, it is the responsibility of the doctoral committee to determine whether another examination may be taken. The approval of the dissertation rests entirely with the doctoral committee and the EE Department Head. Students will have their dissertation submissions digitally signed by their committee and the department through the Electronic Thesis and Dissertation application.

Final oral exams and dissertation submissions must meet The Fox Graduate School's published deadlines for graduation.

E. Other Constraints

To be eligible for the qualifying, comprehensive, and final oral exams, a student must have a minimum grade point average of 3.00, must be registered, must have no missing or deferred grades, and must have satisfied any provisional requirements for admission.

Over a twelve-month period, while enrolled in the PhD program, the student must be registered for full-time academic work at the University Park campus for at least two consecutive semesters (excluding summer).

After passing the comprehensive exam, a student must maintain continuous registration for each fall and spring semester until they defend their thesis. Students who fail to register will be assessed tuition for any semester in which they did not register before being permitted to continue their PhD studies.

V. Policies for Graduate Assistants

A. General Policies

1. Types of Appointments

The typical Assistantship Appointment (RA or TA) in Electrical Engineering is a half-time appointment, which requires 20 hours of work per week. The pay rates may vary depending on the nature of the job and the student's experience. The assistantship pays the student's tuition (must be registered for 12 credits per semester), 80% of the student's health insurance premium and a monthly stipend during the period of the appointment. Appointments have no guarantee of renewal. Students who have had appointments for both the proceeding fall and spring semesters are eligible to apply for summer tuition assistance (STAP) if they need to be registered for the summer. Students must apply for STAP to be considered.

Appointments may be for a variety of duties generally classified as research (RA) or teaching (TA). Teaching appointments will be supported by internal Department funds. Research appointments are supported by the advisors funded research.

Students who are a TA must take and pass the AEOCPT exam; a score of at least 250/300 is required. With approval from the students advisor the student can enroll in ESL118G to be eligible for a teaching assistant appointment and avoid taking the AEOCPT exam. The Electrical Engineering Department will determine which students will take the AEOCPT exam.

A graduate assistant is not eligible for other forms of employment such as part-time hourly wage payroll, either within or outside of Penn State, unless approval is obtained from ISSA and those supplying the assistantship, the Directory of Graduate Studies. However, a graduate assistant is allowed to receive fellowship funds in addition to the assistantship.

2. Periods of Service

Unless specified otherwise, a semester appointment requires 18 weeks of service, and a summer appointment requires 12 weeks of service. A full year appointment will then be 48 weeks. It is notable that the class is in session for a total of only 44 weeks including exam periods. Research assistants work independently of the academic calendar, more or less, while the responsibilities of teaching assistants are concentrated during the weeks when class is in session. Teaching assistants may have pre-class preparation as well. Refer to BCAC-901 for more information.

3. **Health Insurance**
   All graduate assistants must have health insurance. A person may choose to purchase insurance separately, in which case they must provide proof to the Student Insurance Office in the Student Health Services Building that the insurance meets Penn State standards. This must be done within the first 2 weeks of the fall semester otherwise a student is automatically enrolled in a group health insurance policy, vision care policy, and dental insurance plan for graduate assistants and will pay 20% of the premium through payroll deduction. When requested, health insurance and dental and vision care insurance for the student's eligibility dependents may be included and the student pays 30% of the premium for dependent coverage. Because the details are to numerous to be repeated here, the student should go to the https://studentaffairs.psu.edu/health-insurance/student-health-insurance-plan-penn-state

4. **Pay Periods**
   Stipends are deposited electronically on the last working day of the month to the student's bank account indicated on the salary deposit information they submitted during their on-boarding process. A new arrival likely will not receive the first paycheck on time unless prior processing of the appointment has occurred, however, they will receive the stipend amount for the first and second months of the assistantship at the second pay period.

5. **Supervision and Evaluation**
   Each graduate assistant is assigned to a supervisor, usually a faculty member, who has the responsibility to specify the requirements of the position, to oversee the assistant's work on some regular schedule, and to evaluate the assistant's work, dependability, and readiness to move to higher levels of responsibility.

B. Teaching Assistant Policies

1. Preparation and Training

Electrical Engineering has a positive teaching assistant performance in various capacities including classroom instruction. Student complaints about teaching assistants are not frequent and some have achieved high student ratings for their services. We are careful in our selection of persons to serve, and we strongly advocate preparation and training for specific jobs. Both supervisors and teaching assistants are responsible for ensuring that teaching assistants are properly prepared for their assignments.

During the first semester, a new teaching assistant is expected to enroll in ENGR 888. This is a one-credit course that provides teaching assistants with the opportunity to learn some pedagogy and to discuss problems that arise in the classroom. In this course, teaching assistants can present talks relevant to their assignments and receive feedback from other assistants who are in similar situations.

Teaching assistants should expect to have meetings with their immediate supervisor prior to the start of the semester, and often during the semester. At the beginning of the semester, the teaching assistants should receive a course syllabus, a text, any information to be distributed to students, and specific details about their assignments. Teaching assistants and supervisors are to discuss the instructional goals and objectives of the course and the means to accomplish them. Periodically, meetings should be held to emphasize the purpose of a particular lab or project and how it should be evaluated. Teaching assistants should expect to attend course lectures, especially the first time assigned to a course, to be aware of the instructor's emphasis and expectations of the students.

State law requires teaching assistants whose native language is not English to pass a test of their ability to converse in English, the American English Oral Communications Proficiency Test (AEOCPT). This department appoints only those who have already passed the test that is administered by Penn State's Department of Applied Linguistics. Students who need to take the AEOCPT will be scheduled by the Electrical Engineering Department.

2 Responsibilities

Teaching assistants may expect a wide range of assignments including the following: grading homework, projects, and exams; preparing assignments; preparing solutions for posting or distribution; maintain office hours and holding help sessions; substituting as lecturers when faculty members are out of town ; helping to administer exams including evening exams, and exams in courses other than the primary assigned course; preparing and setting up demonstrations; processing grade data and, in some cases, assigning grades. Teaching assistants are advised to keep a daily log of time devoted to the job and how it divides among various tasks.

Teaching assistants should not be asked to do the following: choose textbooks; prepare a syllabus; lecture regularly; teach a new course; help with a professor's work that is unrelated to the course; or meet with a supervisor outside of the hours from 8:00am-5:00pm except for formally scheduled exams.

3. **Absences**

From time to time, teaching assistants must be absent from an assigned job, yet clearly an unmet class represents a major lapse in responsibility, and it creates a very poor image of the department among the student clientele. In case of illness or planned absences such as professional trips, teaching assistants should notify the supervisor to have the responsibilities covered. It is common for two individuals, students or faculty, to arrange mutual exchanges of responsibilities from time to time to allow for such personal needs. Any emergencies or extended changes should come to the attention of the Director of Academic Affairs who may need to reassign jobs.

4. **Evaluations**

During the first week of the semester, the teaching assistant and supervisor should meet to ensure that start-up details have been completed. Late in the semester, any teaching assistant who has had contact with students will have a Student Educational Experience Questionnaire (SEEQ). Additional information and evaluation guidelines are available from the Schreyer Institute for Teaching Excellence or on their website at https://www.schreyerinstitute.psu.edu/

C. Research Assistant Policies

1. The Research Assistant Appointment and Thesis Preparation

Because a research assistant appointment is normally accompanied by the preparation of a graduate thesis, the research supervisor is usually the thesis supervisor and will have much to say about related course work and other aspects of the research assistant's preparation. The dual aspects of the appointment cannot be separated. Likewise, the evaluation of the research assistant cannot be separated from the evaluation of the thesis preparation. All that can be asked is that the combination of research appointment and the registration for thesis credits represents a realistic workload, especially considering other course work the research assistant may be carrying out.

1. **Work Hours**

The nature of the work may well require that hours be spent outside of the normal hours of 8:00am-5:00pm, Monday-Friday schedule. An obvious example is lidar work must be conducted at night. Lab tests or experiments may require continuous supervision for an extended period of time. Those who accept research assistant positions do so understanding the unusual hours may be expected. No graduate student, research assistant or otherwise, should be expected to be placed in a

situation of personal danger by being asked to work in an environment where that person might be exposed to harassment or assault from fellow workers or strangers. Supervisors are to be sensitive to such issues and to arrange work schedules to provide necessary safeguards for all individuals involved in the work. Concerns should be brought to the supervisor's attention immediately and to the Department Head if not promptly resolved.

2. Responsibilities

Research assistants may be expected to do any of the following: maintain hardware or software; clean equipment and workspaces (but not provide janitorial services); follow prescribed lab and safety procedures; assist in proposal preparation; prepare reports and related graphics; collect and process data; interact with sponsors and vendors; and attend meetings and seminars. Research assistants who do not maintain a clean and sanitary personal office space may lose access to the office space.

Research assistants should not be expected to travel without advances and reimbursements for expenses, to lecture for the supervisor, except for occasional substitutions, or to provide services unrelated to university business, such as consulting or moving household furniture.

D. Other Policies

- **Optional Practical Training (OPT) and Curricular Practical Training (CPT)**
  When applying for OPT or CPT, the student must put their advisor as the faculty approver. Students without an advisor, i.e., students taking the course-based EE594, should put the Director of Graduate Studies as the faculty approver.
- **Reduced Course Load**
  When applying for a reduced course load the student must put the Director of Graduate Studies as the faculty approver. The student must have completed the EE 500 course requirement prior to the RCL semester.

GRADUATION CHECKLIST FOR MS STUDENTS

____THESIS - 6 CREDITS OF EE 600 **OR** _____ PAPER - 3 CREDITS OF 594 ___ COLLOQUIUM - 2 CREDITS

NAME **ID. NUMBER** _____

COMMUNICATIONS, COMPUTERS, NETWORKING, AND SIGNAL PROCESSING	CONTROL AND POWER SYSTEMS	ELECTROMAGNETICS AND OPTICS	ELECTRONICS AND PHOTONICS
CSE 514	EE 580	EE 520	EE 510
CSE 543	EE 581	EE 521	EE 518
CSE 572	EE 582	EE 522	EE 526
CSE 577	EE 584/M E 558	EE 524	EE 541
CSE 578	EE 586	EE 531	EE 542
EE 550/M E 550	EE 587/M E 559	EE 534	EE 543
EE 551	EE 588	EE 535	EE 544
EE 552/CSE 583		EE 537	EE 545/MATSE 545
EE 553		EE 538	EE 546
EE 554/CSE 586		EE 573	EE 547
EE 555/CSE 585		EE 574	EE 549
EE 556		EE 576	
EE 557		EE 579	
EE 559			
EE 560			
EE 561			
EE 562			
EE 564/CSE 554			
EE 565/CSE 515			
EE 567			
EE 568			
EE 569			

Only courses listed above may be used for the breadth area requirements.
As an exception, EE 597 (X) courses must be approved by the Graduate Program Committee (by petition to the Committee) prior to scheduling to be used to satisfy the breadth requirements.

List EE 597 Courses:		**Scholarship and Research Integrity (SARI)** 3 hrs of program specific & 2 hours of general discussion-bassed instruction plus on-line CITI component.	
List 400 level EE courses (maximum 12 credits, 496 not counted)	**List EE 596 course (maximum 6 credits)**	**List external university transferred credits**	**Related 400 & 500-level (no 496 or 596) non- EE courses (advisor approval required, these courses will not count toward EE breadth requirement.)**
M.S. THESIS OPTION	**32 credits** **(24 course credits, 6 thesis research credits, and 2 colloquium credits)**	**500-level minimum 15 course credits**	**Thesis Defense**
M.S. PAPER OPTION	**32 credits** **(27 course credits, 3 paper research credits, and 2 colloquium credits)**	**500-level minimum 18 course credits**	**Paper Presentation**
ALL M.S. STUDENTS	**50% of the required course credits must be *Electrical Engineering Department* courses (excluding colloquium and research)**	**For the breadth requirement, a 500-level course from at least two of the four areas listed above must be successfully completed.**	**Time Limit** 6 years

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