EE:Systems Graduate Program Manual

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1. INTRODUCTION

The Electrical Engineering:Systems (EE:S) Graduate Program Manual provides information on the requirements for the Master of Science (MS) and Doctor of Philosophy (PhD) degrees. Students enrolled in EE:Systems are primarily interested in the area of Systems Science and Engineering.

The EE:Systems Graduate Program is part of the University of Michigan's Horace H. Rackham School of Graduate Studies. The Rackham Graduate School publishes the Graduate School Academic Policies with regulations that apply to all graduate students. EE:S graduate students should consult both this Manual and the Rackham Academic Policies.

The EE:Systems Graduate Program offers three major areas of concentration:

CONTROL: Research focuses on fundamental properties of dynamical systems and developing algorithms to modify their behavior through control in order to satisfy performance objectives. Numerous system models are employed, including linear, nonlinear, stochastic, discrete event and queuing models. The faculty work on a wide variety of applications projects, including automotive powertrain control, manufacturing systems, communication networks, robotics, biped locomotion, aerospace, and intelligent transportation systems.

COMMUNICATIONS: Research focuses on system design, optimization, and performance analysis as well as on the development of theory to characterize the fundamental limits of communication system performance, including its mathematical foundations. Areas of specialization include digital modulation, channel coding, source coding, information theory, optical communications, detection and estimation, spread spectrum communication, and multi-user communications and networks.

SIGNAL PROCESSING: Research in signal processing deals with the representation, manipulation, and analysis of signals, images, video, and other media. Much of the signal processing research is a collaborative activity within other areas of EECS, particularly in the areas of communication, electromagnetics, artificial intelligence, and biosystems. Furthermore there are active interdisciplinary collaborations with the departments of music, medicine, dentistry, biological sciences, genetics, mechanical engineering, nuclear engineering and radiation sciences, statistics, biostatistics, and mathematics. Current projects include: image reconstruction, restoration, and segmentation; fast algorithms; tomography and other inverse problems; wavelets and time-frequency distributions; image and video coding; steganography and watermarking; signal detection and target tracking in electro-optical, acoustic and radar remote sensing; pattern recognition and pattern matching; parameter estimation and performance bounds. Applications include: bioinformatics; psychoacoustics; musical instrument sound synthesis and analysis; MIMO communications; packet switched networking; wireless sensor networks; neural measurements and analysis; medical imaging; and surveillance for security applications.

There are currently two areas under development:

POWER/ENERGY: Research covers power systems and energy processing (power electronics and electromechanical conversion). The focus is on establishing fundamental system properties, and using that knowledge to achieve performance enhancement through systematic design strategies. Projects include dynamic performance of wind generation systems, grid integration of plug hybrid electric vehicles, dynamics and control of microgrids, load control strategies, and robustness of large-scale power systems to parameter uncertainty.

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ROBOTICS AND COMPUTER VISION: Robots are evolving from stationary devices that perform manufacturing tasks to mobile, information gathering, computing, and decision-making platforms. We are working on the modeling, estimation and control of multi-robot (multi-agent) systems for applications ranging from intelligent transportation networks to search and rescue. We are developing the fundamentals of computer vision, the science and technology of giving machines the ability to see, in order to perform real-world visual tasks such as autonomous navigation, visual surveillance, or content-based image and video indexing. We are also exploring the feedback control principles of bipedal robotic locomotion, with the goal of endowing machines with the ability to walk on two legs with the agility of a human.

2. FACULTY/ADVISOR/STAFF

Academic Advisor:
The academic advisor's primary duty is to help design an academic program to meet a student's goals within the course requirements of the graduate program. The academic advisor will also counsel students on the qualifying exams required for the PhD and can offer advice on the research interests of the faculty. There is one academic advisor assigned to each of the three major areas of study.

Research Advisor:
For those students pursuing the PhD, the Research Advisor fulfills two separate advising roles. As a pre-candidate, the Research Advisor is the *Directed-Study Advisor*, overseeing the Qualifying Exam II research and examination. As a candidate, the Research Advisor is the *Dissertation Advisor*, overseeing thesis research. For most students, the Directed-Study Advisor and Dissertation Advisor is the same faculty member.

Graduate Program Coordinator
The Graduate Program Coordinators are the primary contact persons for the EE:S graduate program. The EE:S Graduate Program Coordinators will process paperwork and are an important resource concerning general questions about the graduate programs.

EE:S Program Chair
The EE:S Graduate Chair oversees the running of the Systems Graduate Program, including the academic guidelines, qualifying examinations, recommendation of degrees to the Rackham Graduate School, and petitions for changes in the degree requirements. In addition the Graduate Chair heads a *committee-of-the-whole* made up of the entire EE:S faculty in matters of course requirements, and granting of Ph.D. candidacy through the two qualifying exams.

3. GENERAL ACADEMIC GUIDELINES

3.1 Course Equivalency

If a student has taken a course elsewhere that is "substantially equivalent" to a course in the program, it is not necessary to retake the course provided that the student is awarded equivalency for the course.

Equivalency is only required for courses that are to be substituted for major courses. The student should consult with his/her adviser at the earliest opportunity to determine whether equivalency is appropriate and to make a formal application for equivalency.

Go to the ECE Graduate Program Office or website for the Course Equivalency instruction form.

Please Note: The Qualification 1 exam will cover major courses deemed equivalent. It is the student's responsibility to be sure s/he understands the course material as it is taught in the EE:S Graduate Program.

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3.2 Curricular Practical Training (CPT) for F-1 Students

The intent of CPT is for students to engage in practical job experience that *directly relates to their academic program of study.* Students must choose their internships carefully with the understanding that any job that is NOT specifically related to the applicant's major area of study, will likely result in the denial of the CPT request.

Students who want to enroll in CPT should go to the ECE Graduate Program Office or website for the CPT instruction form and complete all necessary paperwork.

Credit for CPT (Rack 998) may not be counted toward any EE:S degree requirements.

3.3 Dropping Courses

After the eighth week of a full term (fourth week of a half term), courses may be dropped or changed to Visit/Audit status only under exceptional circumstances and with the approval of the course instructor, advisor, and the graduate chair of the program. The Rackham Graduate School rules for dropping courses also apply (see the Rackham Student Handbook).

The specific deadline dates are posted in the ECE Graduate Program Office and website.

3.4 English Proficiency

Based on English language proficiency test scores (such as the TOEFL), some students will be encouraged by the Rackham Graduate School to take specific academic writing or speaking courses offered by the English Language Institute (ELI) to support their studies. The ELI courses are typically 1 to 3 credits, and will help students gain capability and confidence in English. These courses will not count toward the degree or GPA.

A student's English proficiency is also evaluated as the student participates in the oral Qualifying Exams and Research Thesis Proposal presentation. If the faculty considers the student to otherwise be qualified for the EE:S PhD program, it may be recommended the student take English courses. Students with major deficiencies in English will be found Not Qualified for the EE:S PhD Program.

3.5 Enrollment Status

Regarding courses:
Full time enrollment is 8 credit hours.

For GSI/GSRA, full time enrollment is 6 credit hours.

ELI courses do count towards enrollment status.

Visit/Audit of a class does not count towards enrollment status.

Regarding tuition:
For 1-8 credits, you pay an amount for each credit hour.

For 9+ credits, you pay a single amount for all the credits.

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3.6 Grades

All grades are on the Rackham Graduate School scale:

A+	4.3	B+	3.3	C+	2.3	D+	1.3
A	4.0	B	3.0	C	2.0	D	1.0
A-	3.7	B-	2.7	C-	1.7	D-	0.7

Course grade must be B- or better for the credit hours to be counted toward any degree requirement.

The grade point average (GPA) must be at least 3.0, based on Rackham's 4.0 scale. A GPA below a 3.0 will cause the student to lose "satisfactory academic standing".

A student must have a minimum cumulative GPA of 3.0 (B) to be granted a degree.

3.7 Graduation

Graduation for the MS or PhD degree is not automatic. A student who has completed the degree requirements must submit a signed, completed plan of study to the ECE Graduate Program Coordinator as well as apply for graduation via the Wolverine Access System.

The last day to apply for graduation for the current semester is the last day of classes (not the final exam period).

3.8 Honor Code

All engineering programs at the University of Michigan follow the College of Engineering Honor Code outlining certain standards of ethical conduct. The Honor Council investigates reported violations of the Honor Code.

Read more about the policy here: http://www.engin.umich.edu/students/honorcode/index.html

3.9 Major and Minor Areas

The EE:S Master's Program provides students with advanced technical knowledge to better prepare them for careers in industry and/or to provide them the technical foundation that will enable them to better understand the current technical literature so that they can perform research. Accomplishing these goals requires some depth of expertise in a major area as well as a minor area.

Students must select one of the following **MAJOR** areas:
- Communications
- Control Systems (includes Power/Energy)
- Signal Processing (includes Computer Vision)

Students must select a **MINOR** area based on the following criteria:
- a major areas list above that is different than your major area
- the pre-approved minor list:
    - Biosystems
    - Manufacturing

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- o Circuits and Microsystems
- o Computers
- o Applied Electromagnetics and RF Circuits
- o Optics and Photonics
- o Solid State
- an outside area of concentration. A student desiring this must submit a petition outlining a proposed set of courses sufficiently distinct from the major and which constitutes a cohesive curricular concentration. This petition should be presented before the student starts taking the courses.

Master students are allowed to change their major area while in the program. In order to change major area, the student must complete at least one semester in the program.

Student who want to change major are should go to the ECE Graduate Program Office or website for the Change of Major Area instruction form.

3.10 Petition for Waiver or Modification of Policy or Requirement

A student may request special permission to adjust the departmental degree requirements or guidelines for a specific reason or circumstances. It is recommended that the student seek the advice of his/her academic/research advisor before submitting the petition.

A student petitioning for waiver or modification of policy or requirement must complete the Petition Request Form. The student's academic/research advisor must approve this request, and then it is submitted to the ECE Graduate Academic Affairs Committee for final approval.

Go to the ECE Graduate Program Office or website for the Petition Request instruction form.

3.11 Plan of Study

The Plan of Study is the form that maps out which courses satisfy the specific degree requirements. It is recommended that students submit a plan of study at the first and last term of enrollment. Students should meet with his/her academic advisor to discuss the plan and obtain the necessary signature. The Plan of Study may then be modified as the student progresses through the program.

Go to the ECE Graduate Program Office or website for the respective Plan of Study form.

Please Note: It is the responsibility of the student to submit to the ECE Graduate Program Coordinator an updated, signed final Plan of Study when apply for graduation. Failure to submit the plan of study can result in a delay in graduation.

3.12 Reduced Course Load (RCL) for F-1 Students

International students, who drop below full time status or who need fewer than 8 credits to complete their program requirements, may apply for RCL through the International Center.

Students who wants/needs a RCL should go to the ECE Graduate Program Office or website for the RCL instruction form.

Please note that students are eligible for RCL only if they have not yet completed their degree requirements. Due to Federal regulations, students must apply for their degree in the semester in which they complete their degree requirements. If a student wants to remain in the country after completing their requirements, they must apply for OPT (processing OPT applications typically requires 60 to 90 days).

3.13 Transfer of Credit

Students who want to transfer credit must follow the Rackham transfer of credit guidelines.
- A student is allowed to transfer up to 6 credits can be transferred from external institutions or 15 credits can be transferred from the University of Michigan.
- These credits must be used in whole and cannot be split (e.g. only use 2 of the 4 credits)

To transfer credits:
- Student must complete 8 credits of graded graduate courses at the University of Michigan to transfer credits.
- Student must have a minimum GPA of 3.0.

Transfer credits must meet the following criteria:
- Be a graduate level course
- Receive a "B" grade or higher
- Cannot be used to satisfied degree requirements for undergraduate or graduate degree. (In other words, they must be extra credits taken.)

Go to the ECE Graduate Program Office or website for a Transfer of Credits instruction form.

5. MASTER'S DEGREE REQUIREMENTS

To receive a master's degree, a student must satisfy the EE:S Graduate Program requirements outlined below as well as the Rackham School of Graduate Studies General Master's Degree Requirements as stated in the Rackham Graduate School Academic Policies and the College of Engineering Regulations as specified in the College of Engineering Bulletin.

Students interested in transitioning from EE:S MS to EE:S PhD should refer to the Qualification 1 exam section of this manual for further explanation of eligibility requirements.

5.1   Master's Credit Distribution

The MS degree requires a minimum of <u>30 graduate credit hours</u> with the following distribution:

- 9 credits in a major area (6 credits at 500 level or higher)
- 6 credits in a minor area (3 credits at 500 level or higher)
- 4 credits in a cognate area
- 12 credits in 500 level or higher EECS courses
- 24 credits in technical courses. Technical courses are:
  - Any engineering, math, physics, or general science course.
  - The academic advisor must approve courses from Economics, Business, etc..
- **Optional:** 4 credit (maximum) of research, independent/directed Study, or any S/U graded courses

Please Note:
- All course unless noted cannot be graded satisfactory/unsatisfactory.
- Math 404, 417, 425, 448, 450 and their cross-listed courses may <u>not</u> be counted for any degree requirements.
- Rack 998 (Curricular Practical Training) may <u>not</u> be counted for any degree requirements.
- Courses with number 990, 995 or other course with "doctoral," "dissertation," or "preliminary" in the title may not be counted towards MS degree requirements.

5.2   Master's Thesis Option

The option of writing a Master's thesis is available to Master's students in good academic standing. A student who wants to exercise this option may initiate the process through three steps:
- find an EECS faculty member willing to serve as the Thesis Advisor
- enroll in the Master's thesis course for one to six credit hours
- arrange for a Master's Thesis Committee to be approved by the EE:S Graduate Chair.

The Master's Thesis Committee will consist of the Thesis Advisor, as chair, and two additional faculty members. The committee members will be available for consultation and will evaluate the thesis. The Thesis Advisor is responsible for supervising the work of the Master's thesis project.

The student must satisfactorily complete the Master's thesis course for a maximum of six (6) credit hours. These credit hours may be spread over more than one term. The course may be taken for one to six credit hours per term and shall be graded on an S/U basis.

The student must write a report that is substantially consistent with the Rackham format for theses. Each member of the Master's Thesis Committee must submit a written evaluation of the thesis. Approval of the thesis by all committee members is required. In addition to the thesis, the Master's Thesis Committee may request an oral report.

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The student must elect the thesis option within thirteen months of first enrolling in the Master's program. The thesis must be completed within twelve (12) months of the initial election of the thesis course.
Students interested in changing status from EE:S MS to EE:S PhD *after completion of the MS degree requirements,* must follow the same procedure as non-U-M applicants by completing the Rackham Graduate School online application for PhD admission the term after completion of the MS degree.

5.3 Timeline and Deadlines

Students are able to complete the program in 3 or 4 semesters. The timeline below displays a "typical" four-semester progression in the MS program.

Students must complete all work for the MS degree within five years from the date of first enrollment in the program. Those exceeding this limit must petition Rackham for a time extension or be withdrawn from the program.

Academic Term	Credit Hours	Research Activities (optional)	Milestones
Year 1: Fall	8-9 credits	Search for a research advisor	GPA
Year 1: Winter	8-9 credits	Choose research advisor for MS thesis or transition to PhD	GPA
Year 1: Sp/Su		Independent study or MS thesis research	
Year 2: Fall	8-9 credits	Independent study or MS thesis research	GPA, **Optional:** Apply for MS Degree
Year 2: Winter	3-6 credits	Complete MS thesis research	GPA, Apply for MS Degree

5.5 Transition from EE:S Master's to EE:S PhD

Students interested in transitioning from EE:S MS to EE:S PhD must follow the steps below:

After completion of MS degree requirements:
- Follow the normal PhD admission cycle and process as non-UM students.

Prior to completion of the MS degree requirements:
- Follow the rules and timetable for the PhD qualification exam: take 4 courses approved for the Qualification 1 exam during the first and second terms of enrollment.
- Initiate a research relationship with an EECS faculty member.
- Submit a Qualification 1 exam application for the May, September, or January exam, which is signed by the faculty member with whom research has either begun or is about to begin. *The EECS faculty member who is advising the student and offering financial support must sign this application.*
- Take and pass the Qualification 1 exam.
- Complete the Rackham application for PhD. (Note: letters of recommendation, statement of purpose, etc. are not required since they are on record from the MS application.)

Please Note: Financial support in the form of a research assistantship from a faculty member is necessary (but not sufficient) for transitioning from MS to PhD.

6. DOCTORAL DEGREE REQUIREMENTS

The doctoral degree (PhD) is conferred in recognition of marked ability and scholarship in a broad field of knowledge and the demonstrated ability to carry out independent research yielding significant original results. The Doctoral Program proceeds in three stages: (i) qualification, (ii) achieving candidacy, and (iii) writing and defending the dissertation.

To receive a PhD degree, a student must satisfy the EE:S Graduate Program requirements outlined below as well as the requirements as stated in the Rackham Graduate School Academic Policies and the College of Engineering Regulations.

6.1 PhD Credit hours and Course Distribution

The PhD degree requires a minimum of 36 graduate credit hours with the following distribution:

- 6 courses in a major area
- 3 courses in a minor area
- 4 credits of a cognate area
- 12 credits in 500 level or higher EECS courses
- 24 credits in technical courses. Technical courses are:
    - Any engineering, math, physics, or general science course.
    - The academic advisor must approve courses from Economics, Business, etc..
- **Optional:** 4 credit (maximum) of research, independent/directed Study, or any S/U graded courses

Please Note:
- All courses cannot be graded satisfactory/unsatisfactory unless noted.
- Math 404, 417, 425, 448, 450 and their cross-listed courses may not be counted for any degree requirements.
- Rack 998 (Curricular Practical Training) may not be counted for any degree requirements.

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6.2   Relevant Master's Degree

If a student entering the EE:S program already has a MS degree, it is determined at the time of admission if the MS degree course work is very similar to the EE:S MS degree requirements/course work. If the course work is very similar, it is deemed to be relevant. The student is then granted 18 credit hours toward the PhD. The student must still meet the EE:S candidacy course requirements, either through equivalency or by taking the required coursework.

Please Note: A student with a Relevant MS degree cannot earn a MS degree in EE:Systems. Failing a Qualifying Exam with a Relevant MS degree means the student must terminate PhD study in EE:S and leave the EE:S Program without receiving any degree.

6.3   PhD Progress and Financial Support

As stated in the offer letter, continued enrollment and guaranteed financial support is contingent upon satisfactory academic and research progress on the part of the student in his/her academic program.

- The student will be periodically informed about his/her academic performance.

Yearly student evaluations will be conducted in April, with a due date of April 30. The student and his/her research advisor will complete and sign the progress report. This report will identify one of three outcomes regarding the student's overall academic and research progress: "Satisfactory"; "Concerns"; "Unsatisfactory". Submission of this report is mandatory.

The Graduate Chair may request a student to submit a progress report prior to the April yearly evaluation.

- When the student's progress is deemed not satisfactory ("Concerns" or "Unsatisfactory"), updated progress reports will have to be submitted, as required by the program's Graduate Chair; at these times, the student's overall progress will be re-evaluated.

- Lack of submission of a progress report or of an updated progress report will automatically lead to an "Unsatisfactory" rating.

- Lack of satisfactory progress may lead to the termination of the guarantee of financial support and to the discontinuation from the graduate program.

- A student with guaranteed financial support will be told in writing at least two months before his/her stipend actually ends. If the stipend is terminated during a term in which the student is enrolled, outstanding financial obligations including tuition, associated fees, and benefits will be covered until the end of the given term.

6.4   PhD Degree Timeline

Below is the typical timeline for the PhD student. Because of the nature of the research and degree itself, the PhD is unique to each student and is subject to greater leeway in timing. Nevertheless, the EE:S Program expects the majority of students to complete the PhD degree within five years. Students who take longer than 5 years to complete the PhD degree may lose departmental financial aid. Rackham's time to degree is 7 years from first enrollment in the program. Students not completing the degree in 7 years must submit a petition to Rackham requesting an extension.

Academic Term	Curricular Activities	Research Activities	Milestones
Year 1: Fall	3 courses	departmental and area research seminars, faculty/student research meetings	GPA
Year 1: Winter	3-4 courses, prepare for the Qualification 1	departmental and area research seminars, faculty/student research meetings	GPA, pass Qualification 1, identify a research advisor for Qualification 2
Year 1: Sp/Su			identify a topic for Qualification 2 research project, begin preliminary readings and a preliminary problem statement
Year 2: Fall	2-3 courses directed research	faculty/student research meetings in area of interest, directed research with research advisor	GPA, refine the problem statement and begin research, complete MS degree requirements and apply for MS degree
Year 2: Winter	2-3 courses + directed research, prepare for Qualification 2 exam		GPA, complete research, write up results as a report for the Qualification 2 exam committee, successfully defend research in the Qualification 2 exam and become a PhD candidate when course requirements are satisfied
Year 2: Sp/Su			
Year 3: Fall	2-3 courses to complete PhD course requirements or 1 course (max) + EECS 995, if already a candidate	research with research advisor, faculty/student research meetings in other areas of interest	problem formulation, preliminary readings and derivations for PhD Thesis Proposal
Year 3: Winter	1 course (max) + EECS 995	research with research advisor, faculty/student research meetings in other areas of interest	problem statement, refinement, form dissertation committee and present a Thesis Proposal
Year 3: Sp/Su			
Year 4: Fall	1 course (max) + EECS 995	PhD research	Update dissertation committee on research progress (at least once during the academic year)
Year 4: Winter	1 course (max) + EECS 995	Ph.D. research	Update dissertation committee on research progress (at least once during the academic year)
Year 4: Sp/Su			
Year 5: Fall	1 course (max) + EECS 995	Ph.D. research	Update dissertation committee on research progress (at least once during the academic year)
Year 5: Winter	1 course (max) + EECS 995	Ph.D. research	Final defense of dissertation before dissertation committee, complete any dissertation revisions, graduate with PhD
Year 5: Sp/Su			

6.5 PhD Degree Deadlines

Experience has shown that successful doctoral students devote a majority of their time to their academic program. Consequently, these deadlines apply to all EE:S students, including those with GSI (Graduate Student Instructor) or RA (Research Assistant) appointments, as well as those carrying outside obligations.

Any departure from the timetable must be explicitly requested by written petition. The EE:S Graduate Committee will review each petition, and each decision will be made on the individual merits of the petition. The Graduate Committee may terminate the enrollment of any student who fails to follow these procedures.

Students entering the EE:S Graduate Program with a Bachelor's degree:

1. Successfully complete Part 1 of the Qualifying Examination for the Doctoral Program within 13 months of entry
2. Successfully complete Part 2 of the Qualifying Examination for the Doctoral Program within 25 months of entry (such students are strongly encouraged to take Part II within 21 months)
3. Achieve Candidacy within 36 months of entry
4. Present a research proposal to a dissertation committee within 36 months of entry
5. Complete the dissertation within six years of entry. (Ordinarily the entire PhD program should take no more than five years to complete.)

Students entering the Graduate Program with a relevant Master's degree:

1. Successfully complete Part 1 of the Qualifying Exam for the Doctoral Program within 13 months of entry
2. Successfully complete Part 2 of the Qualifying Examination for the Doctoral Program within 21 months of entry (such students are strongly encouraged to take Part II within 18 months)
3. Achieve Candidacy within 30 months of entry
4. Present a research proposal to a dissertation committee within 30 months of entry
5. Complete the dissertation within five years of entry. (Usually the entire Ph.D. program should take no more than four years to complete.)

7. PhD QUALIFICATION EXAMS

Qualification for the PhD degree occurs in two stages: Qualification 1 and Qualification 2.

The Qualification 1 exam is taken in or shortly after the first year of study. After passing Qualification 1, the student works on research in the form of a Research-Oriented Directed Study or Master's thesis to prepare for the Qualification 2 exam.

The Qualification 2 exam is taken by the end of the second year and examines the student's research capabilities. After successfully passing Qualification 2, the student proceeds to Candidacy and the presentation of the Research Thesis Proposal and ultimately the final defense of the Dissertation.

7.1 Qualification 1 Exam

Qualification 1 is an oral examination to evaluate the student's basic knowledge in the field as well as his/her ability to interrelate various topics and concepts, analyze problems, and synthesize solutions.

Questions are based on material from the Doctoral Qualifying Course Work taken in the first year and are typically application of knowledge rather than memorization of information.

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Qualification Course Work:

As part of the qualifying process, a student must complete a set of courses known collectively as the Doctoral Qualification Course Work. This course work is a subset of the Doctoral Course Work required for Candidacy and consists of a total of 4 courses that can be divided either as:

Option1   Option 2
3 courses in Major   4 courses in Major
1 course in EE:S Minor (See note below)   no Minor courses

Note: The 4 courses selected for the Qualifying I exam must be EE:S courses, unless a petition is filed and approved. If the student is pursuing a minor in an area of study outside EE:S, he/she must be examined on 4 EE:S courses in the major area of study (Option 2).

Grades are an important factor taken into consideration for the Qualification exams. While no threshold has been set, statistics show that students who become candidates generally have an average GPA of at least an 3.7 (A-).

Qualification 1 Background Information:

Beyond the material taken in the 4 listed courses, the student is expected to have a basic understanding of undergraduate material from the major area:

Area   Relevant Course
Communications   EECS 455
Control   EECS 460
Signal Processing   EECS 351

Scheduling of Qualification 1 Exam:

Qualifying exams are offered during a three-week period, near the beginning of the Fall, Winter and Spring terms. At least six weeks prior to the exam, the student must submit a Qualification Exam Application.

To be eligible to take the Qualification 1 exam, at the time of the exam application, a student must have taken the necessary coursework and be making satisfactory academic progress based on performance in the course work taken during the first academic year, the overall academic record, and English proficiency. The student must be engaged in research with a faculty member who is eligible to supervise EE:S students, or have identified such a faculty member with whom he/she will begin to do research.

Examiners:

A Qualification Exam Committee consisting of three faculty members appointed by the EE:S Graduate Committee administers the exam. The faculty members are selected based on the student's Doctoral Qualification Course Work. Following the exam, each member of the Examining Committee will submit an evaluation of the student's performance to the EE:S Faculty.

Qualification 1 Decision:

The decision to approve a student for continued doctoral study is made by the EE:S Faculty, which meets at the end of each qualification exam period. The decision is based on performance in the course work taken during the first academic year, the performance during the Qualification 1 Exam, the overall academic record, and English proficiency.

Possible decisions are:
- Approved for continued doctoral study (Students with minor deficiencies in English proficiency may be required to satisfactorily complete certain English language courses).
- Not approved for continued doctoral study, but allowed to retake Part 1 of the Qualifying Examination.
- Not approved for continued doctoral study, and not permitted to retake Part 1 of the Qualifying Examination.

A MS student who passes Qualification 1 may apply for the EE:S PhD program via the Rackham application website. The decision to accept will be based on the student's performance in coursework and research, as well as the commitment of his/her advisor to work with and support the student. Such an application must be made within 15 months of entry into the EE:S MS program. A student who is admitted to the PhD program will be guaranteed financial support until five years from the date of his/her entry into the EE:S MS program, provided satisfactory progress continues to be made.

Qualification 1 Timing:

All students entering the EE:S Graduate Program are encouraged to take Qualification 1 within 9 month of entry and must be approved for continued study in the doctoral program within 15 months.

Each student has a maximum of two opportunities to take the examination.

7.2   Research-Oriented Directed Study

Upon passing Qualification 1 (if not before), a student will begin work on the Research-Oriented Directed Study under the supervision of his/her Research Advisor, who, in general, is a member of the EE:S Faculty. It should include background study in the selected topic area and the beginning of original research. The student should write a concise report summarizing this work. This report is due at the time of application for Qualification Exam Part 2.

The amount of research required is commensurate with a three hour directed study for two semesters (6 hours total). An oral presentation of the work is included in the Qualification 2 exam. In addition, the research advisor writes an evaluation of the student's work and research capabilities. The student may register for Research Work in EECS 599 or 699 while pursuing the Research Oriented Directed Study. However, this is not required to take Qualification 2.

In many cases the topic of the Research-Oriented Directed Study develops into a dissertation topic and the research advisor becomes the Dissertation Advisor. Accordingly the student should choose the topic and research advisor with care.

7.3   Qualification 2 Exam

Qualification 2 is an oral exam intended to examine the student's research capabilities. The student will make a short presentation (30 minutes or less) describing the area of research investigated during the Research-Oriented Directed Study and will be questioned by a three-member examining committee. The student must demonstrate an understanding of his/her chosen research area. In addition, some preliminary results (positive or negative) must be obtained.

Scheduling of Qualification 2 Exam:

Qualifying exams are offered during a three-week period, near the beginning of the Fall (Sept.), Winter (Jan.) and Spring (May) terms. The student must submit a Qualification 2 Exam Application and submit a written report of the Research-Oriented Directed Study to the examining committee.

Examiners:

A Qualification Exam Committee consisting of three faculty members appointed by the EE:S Graduate Committee administers the exam. The exam committee is selected to reflect the student's technical areas of research. None of the examiners will be the Research Advisor.

Qualification 2 Decision:

The decision to qualify for the doctoral program is made by the EE:S faculty, which meets at the end of each Qualificaton exam period. The decision is based on the Research-Oriented Directed Study, the Qualification 2 exam, doctoral course work, the overall academic record, and English proficiency (both written and oral).

Possible decisions are:

1. Qualified for the Doctoral Program (Students with minor deficiencies in English proficiency may be a required to satisfactorily complete certain English language courses.)
2. Not qualified for the Doctoral Program but allowed to retake Part 2 of the qualifying examination.
3. Not qualified for the Doctoral Program.

Qualification 2 Timing:

Students entering with a Bachelor's Degree must pass Qualification 2 and qualify for the Doctoral program within 25 months of entry but are strongly encouraged to take the exam within 21 months. Students entering with a relevant Master's Degree must pass Qualification 2 and qualify for the Doctoral program within 21 months of entry but are strongly encouraged to take the exam within 18 months.

Each student has a maximum of two opportunities to demonstrate research ability through the Qualification 2 exam.

8. PhD CANDIDACY

Candidacy signifies that all PhD requirements with the exception of writing and defending the dissertation have been completed. A topic is selected for the dissertation; a Research Thesis Proposal is presented to the Dissertation Committee of which the Chair is the Research Advisor; and subsequent successful writing and defending of the doctoral dissertation fulfill the requirements for the PhD degree.

8.1 Candidacy Requirements

1. Completed 36 credit hours as described in the PhD Credit Hours and Course Distribution section.

2. Passed Qualification 2 exam.

3. Satisfied all Rackham candidacy requirements.

Completing the course work required for candidacy normally takes place parallel to the Research-Oriented Directed Study. Rackham expects students to achieve candidacy no later than three calendar years after the first enrollment in their doctoral program. A student who does not achieve candidacy within three years will be placed on academic probation, unless the graduate program petitions Rackham to request additional time because of extenuating circumstances.

Candidacy is not automatic; once all EE:S and Rackham requirements are met, a student must apply for candidacy by submitting the appropriate forms.

8.2 Candidacy Course Enrollment

Once a student has attained Candidacy status, he/she will enroll in 8 credits of EECS 995 each term. Tuition reduces to the Candidacy rate.

In addition to EECS 995, candidates may elect one course per term without paying tuition beyond candidacy tuition. This course may be taken for credit or as a visit (audit. A student who does not elect a course during a term of 995 enrollment may elect two courses in the next term of 995 enrollment; no more than one course may be deferred in this manner (an additional course may not be taken in anticipation of taking none in a future term of 995 enrollment). Candidates who choose to take more courses than those for which they are eligible with candidacy tuition will be assessed additional tuition per credit hour.

 It is the student's responsibility to cover the tuition costs for any courses taken in addition to the free course described above, even if the student is being funded through a fellowship, GSI or GSRA position.

9. RESEARCH THESIS PROPOSAL PRESENTATION

After passing Qualification 2, a student typically continues to work with his/her Research Advisor who becomes the Dissertation Chair. (A student may also have a co-chair.) The Dissertation Chair(s) play the primary role in guiding the student toward completion of the PhD. The chair(s) also assist the student in forming the Dissertation Committee.

After a period of further research, the student will write a concise Research Thesis Proposal and give a formal oral presentation of the work to the Dissertation Committee. The written Thesis Proposal must be submitted to the committee at least two weeks in advance of the oral presentation.

During the Thesis Proposal Presentation, the student should:

1. Precisely identify and describe the area of research.
2. Demonstrate an in-depth understanding of the area including mastery of the literature on the subject area.
3. Give a general description of the research problem to be addressed.
4. Provide an outline of the methodology to be taken.

During and after the Research Thesis Proposal Presentation, the Committee will explore the proposed research with the student in order to provide guidance and make and evaluation if its suitability. The Committee will determine if the student has or does not have an acceptable proposal.

Failure to have an acceptable proposal requires revising the proposal and scheduling another formal presentation to the Committee. If the proposal is not acceptable, the student has 12 months to prepare and present a satisfactory proposal.

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Timing of Research Thesis Proposal Presentation:

Students entering the Doctoral Program with a Bachelor's degree must write and orally present the Research Thesis Proposal within 36 months of entry to the program. Students entering the Doctoral program with a Relevant Master's degree must present within 30 months.

10. DISSERTATION DEFENSE

10.1 Dissertation Committee

In collaboration with the Dissertation Chair(s), the student forms a Dissertation Committee following specific guidelines regarding the composition of the Committee.

Among these rules are the following for students in the EE:S PhD Program:

1. The committee must consist of four or more members; at least two of the members must be affiliated with the EE:S program.

2. The Research Advisor (or Co-Advisors) will serve as Chair (or Co-Chairs) of the committee. The Chair, or at least one of the Co-Chairs, must be from the EECS Department. EE:S, EE and CSE faculty may serve as chairs on any committee.

3. In accordance with Rackham rules, one of the Committee members is designated as "cognate member." The cognate member must be from outside ECE (EE:S and EE). CSE faculty may serve as cognates.

For detailed dissertation committee formation guidelines, refer to the Rackham website.

10.2 Dissertation Progress Reviews

Once the student has successfully presented the Research Thesis Proposal, he/she should meet informally (or formally, at the discretion of the Dissertation Chair). The student should meet with the Dissertation Committee at least once per year. During these meetings the committee will determine if the student is making satisfactory progress toward finishing the dissertation. The committee, at the request of the Dissertation Chair, will report to the ECE Graduate Committee if the student is not making satisfactory progress. After two consecutive unsatisfactory progress reports the ECE Graduate Committee may terminate the enrollment of the student in the EE:S doctoral program.

10.3 Dissertation Final Defense

Each PhD Candidate must prepare a dissertation, giving evidence of his/her ability to conduct original, advanced research and to present the results of that research in well-written form.   The student must also defend the work orally in an open examination called the Final Defense.

A final and complete copy of the written dissertation must be given to each member of the Dissertation Committee at least 17 business days before the scheduled date of the Final Defense to allow sufficient time for a written evaluation. The Final Defense will only be held if the Dissertation Committee deems the dissertation acceptable. Once all members of the Dissertation Committee find the dissertation acceptable, the Final Defense is held.

In most cases, the student will be required to make some minor revisions to the dissertation based on the Committee comments during the Final Defense. Once all corrections are made, the Committee recommends to Rackham conferral of the PhD degree.

10.4   Final Defense Timing

The student must be enrolled in 8 hours of EECS 995 the term of the Final Defense. The student must defend and complete all Rackham degree requirements before the final doctoral degree deadline for the term.

11. EE:S MAJOR AREA COURSES:

11.1 CONTROL

Major
For MS Degree: Three courses from the following list: EECS 460, 461, 501, 558, 560, 561, 562, 564, 565, 566, 567, 662, NAVARCH 531

For PhD QUALIFICATION: EECS 560; two from EECS 501, 558, 562, 565

For CANDIDACY: Three courses beyond the qualification coursework from EECS 501, 502, 558, 561, 562, 564, 565, 566, 567, 600, 662, Math 451, NAVARCH 531, except that a student may not count both 600 and Math 451

Alternatively, the student may elect other courses having significant control content and/or relevant to the student's area of research. Permission to take such courses must be obtained from the EE:S Graduate Chair based upon the recommendation of the student's academic advisor.

Minor
For MS Degree: Two courses from the following list: EECS 460, 461, 501, 558, 560, 561, 562, 564, 565, 566, 567, 662

For PhD QUALIFICATION: any one from 460, 558, 560

For CANDIDACY: Three courses from the following list: EECS 460, 501, 558, 560, 561, 562, 564, 565, 566, 567, 662, NAAVARCH 531

Course Titles:
EECS 460	Control Systems Analysis and Design
EECS 461	Embedded Control Systems
EECS 501	Probability and Random Processes
EECS 502	Stochastic Processes
EECS 558	Stochastic Control
EECS 560	Linear Systems Theory
EECS 561	Design of Digital Control Systems
EECS 562	Nonlinear Systems and Control
EECS 564	Estimation, Filtering and Detection
EECS 565	Linear Feedback Control Systems
EECS 566	Discrete Event Systems
EECS 567	Introduction to Robotics: Theory and Practice
EECS 600	Function Space Methods in System Theory
EECS 662	Advanced Nonlinear Control
Math 451	Advanced Calculus I
NAVARCH 531	Adaptive Control

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11.2 COMMUNICATIONS

<u>Major</u>
For MS Degree: EECS 501; plus two of the following: EECS 455, 502, 550, 553, 554, 555, 557, 564, 650, except that the following pair is not allowed: (455,554)

For PhD QUALIFICATION: EECS 501, EECS 554; and one from: EECS 502, 550, 553, 555, 557, 650

For CANDIDACY: EECS 501, EECS 554, EECS 600 or Math 451; and three more from the following: EECS 502, 550, 553, 555, 557, 564, 650

Alternatively, the student may elect other courses having significant communications content and/or relevant to the student's area of research. Permission to take such courses must be obtained from the EE:S Graduate Chair based upon the recommendation of the student's academic advisor.

<u>Minor</u>
For MS Degree: any two from the following: EECS 455, 501, 550, 554, 555, 557, except that the following pair is not allowed: (455,554)

For PhD QUALIFICATION: any one from the following: EECS 501, 550, 553, 554, 555, 557, 650

For CANDIDACY: any three from the following: EECS 501, 550, 553, 554, 555, 557, 650

<u>Course Titles:</u>
EECS 455	Digital Communication Signals and Systems
EECS 501	Probability and Random Processes
EECS 502	Stochastic Processes
EECS 550	Information Theory
EECS 553	Theory and Practice of Data Compression
EECS 554	Introduction to Digital Communication and Coding
EECS 555	Digital Communication Theory
EECS 557	Communication Networks
EECS 564	Estimation, Filtering, and Detection
EECS 600	Function Space Methods in System Theory
EECS 650	Channel Coding Theory
Math 451	Advanced Calculus I

11.3 SIGNAL PROCESSING

<u>Major</u>
For MS Degree: EECS 501 and EECS 551, and one more from: EECS 442, 502, 516, 542, 545, 553, 556, 559, 564, 600, 659

For PhD QUALIFICATION: EECS 501 and EECS 551, and one more from: 502, 516, 545, 553, 556, 559, 564, 659

For CANDIDACY: EECS 501, 551, 564; and three more from: EECS 442, 502, 516, 542, 545, 550, 553, 556, 558, 559, 560, 600, 659, Math 451, Math 651, Stat 601, Stat 605, Stat 610, Stat 611

Alternatively, the student may elect other courses having significant signal processing content and/or relevant to the student's area of research. Permission to take such courses must be obtained from the EE:S Graduate Chair based upon the recommendation of the student's academic advisor.

<u>Minor</u>
For MS Degree: two from: EECS 442, 452, 501, 542, 545, 551, 553, 556, 559, 564, 659

For PhD QUALIFICATION: one from: EECS 501, 545, 551, 553, 556, 559, 564, 659

For CANDIDACY: three from EECS 442, 452, 501, 542, 545, 551, 553, 556, 559, 564, 659

<u>Course Titles:</u>
EECS 442	Computer Vision
EECS 501	Probability and Random Processes
EECS 502	Stochastic Processes
EECS 516	Medical Imaging Systems
EECS 542	Vision Processing
EECS 545	Machine Learning
EECS 550	Information Theory
EECS 551	Mathematical Methods for Signal Processing
EECS 553	Theory and Practice of Data Compression
EECS 556	Image Processing
EECS 558	Stochastic Control
EECS 559	Advanced Signal Processing
EECS 560	Linear Systems Theory
EECS 564	Estimation, Filtering and Detection
EECS 600	Function Space Methods in System Theory
EECS 659	Adaptive Signal Processing
Math 451	Advanced Calculus I
Math 651	Topics in Applied Mathematics
Stat 601	Analysis of Multivariate and Categorical Data
Stat 605	Advanced Topics in Modeling and Data Analysis
Stat 610	Statistical Inference
Stat 611	Large Sample Theory

12. EE:S MINOR AREAS COURSES:

The minor area must be different from the major. Students may select from an area other than the major within EE:S, from the areas below, or from an outside area of concentration with approval.

12.1 Biosystems (Biosignals and Imaging)

<u>Minor:</u>
For MS Degree: Two courses from the list below, including at least one 500 level or above

For CANDIDACY: Three courses from the list below, including at least two at 500 level or above: EECS 417, 435, 458, 516, 545, 559 and BME 510, 519.

<u>Course Titles:</u>
EECS 417   Electrical Biophysics
EECS 435   Fourier Optics
EECS 458   Biomedical Instrumentation and Design
EECS 516   Medical Imaging Systems
EECS 545   Machine Learning
EECS 559   Advanced Signal Processing
BME 510   Medical Imaging Laboratory
BME 519   Quantitative Physiology

Other biosignals and imaging courses may qualify with advisor approval

12.2 Manufacturing

<u>Minor</u>:
For MS: Two courses from the list below, including one at the 500 level and above.

For CANDIDACY: At least three courses from the list below; with two or more courses at the 500 level or above.

<u>Course Titles:</u>
EECS 569   Production Systems Engineering
ME 401   Statistical Methods for Manufacturing Systems
ME 555   Design Optimization
IOE 416   Queuing Systems
IOE 441   Production and Inventory Control
IOE 466   Statistical Quality Control
IOE 541   Inventory Analysis and Control
IOE 616   Queuing Theory
IOE 645   Topics in Reliability and Maintainability

12.3 MEMS & Microsystems

<u>Minor:</u>
For MS Degree: At least two courses from the following groups, including at least one course at the 500 level or above.

For CANDIDACY: At least three courses from the following four groups, including at least two courses at the 500 level or above.

      Digital Circuits/VLSI: EECS 427, 478, 523, 627
      Analog Circuits: EECS 411, 413, 430, 511, 522, 525
      Micro fabrication Technology: EECS 421, 423, 425, 512, 513, 514, 515, 517, 523, 528
      MEMS: EECS 414, 425, 503, 509, 514, 515, ME 553

<u>Course Titles:</u>
EECS 411	Microwave Circuits I
EECS 413	Monolithic Amplifier Circuits
EECS 414	Introduction to MEMS
EECS 421	Properties of Transistors
EECS 423	Solid-State Device Laboratory
EECS 425	Integrated Microsystems Laboratory
EECS 427	VLSI Design I
EECS 430	Radiowave Propagation and Link Design
EECS 478	Logic Circuit Synthesis and Optimization
EECS 503	Introduction to Numerical Electromagnetics
EECS 511	Integrated Analog/Digital Interface Circuits
EECS 512	Amorphous and Microcrystalline Semiconductor Thin Film Devices
EECS 513	Flat Panel Displays
EECS 515	Integrated Microsystems
EECS 517	Physical Processes in Plasmas
EECS 522	Analog Integrated Circuits
EECS 523	Digital Integrated Circuit Tech.
EECS 525	Advanced Solid-State Microwave Circuits
EECS 528	Principles of Microelectronics Process Technology
EECS 627	VLSI Design II
ME 553	Microelectromechanical Systems

12.4   Computers

<u>Minor:</u>
For MS Degree: Any two courses from one of the groups listed below, including one at the 500 level.

For CANDIDACY: Any three courses below, including two at the 500 level and at least two from the same group:

<u>Course Titles:</u>

EECS 427	VLSI Design I
EECS 470	Computer Architecture
EECS 473	Advanced Embedded Systems
EECS 475	Introduction to Cryptography
EECS 477	Introduction to Algorithms
EECS 478	Logic Circuit Synthesis and Optimization
EECS 481	Software Engineering
EECS 482	Introduction to Operating Systems
EECS 483	Compiler Construction
EECS 484	Database Management Systems
EECS 485	Web Database and Information Systems
EECS 487	Interactive Computer Graphics
EECS 489	Computer Networks
EECS 490	Programming Languages
EECS 492	Introduction to Artificial Intelligence
EECS 527	Layout Synthesis and Optimization
EECS 545	Machine Learning
EECS 547	Electronic Commerce
EECS 570	Parallel Computer Architecture
EECS 571	Principles of Real-Time Computing
EECS 573	Microarchiitecture
EECS 574	Computational Complexity
EECS 575	Advanced Cryptography
EECS 577	Reliable Computer Systems
EECS 578	Computer-Aided Design Verification of Digital Systems
EECS 579	Digital System Testing
EECS 580	Advanced Computer Graphics
EECS 581	Software Engineering Tools
EECS 582	Advanced Operating Systems
EECS 583	Advanced Compilers
EECS 584	Advanced Database Systems
EECS 586	Design and Analysis of Algorithms
EECS 587	Parallel Computing
EECS 588	Computer and Network Security
EECS 589	Advanced Computer Networks
EECS 590	Advanced Programming Languages
EECS 591	Distributed Systems
EECS 592	Advanced Artificial Intelligence
EECS 595	Natural Language Processing
EECS 627	VLSI Design II

12.6 Applied Electromagnetics and RF Circuits

<u>Minor:</u>
For MS Degree: Two courses from the list below, including one at the 500 level and above.

For CANDIDACY: EECS 530; plus two other courses from the list below, including one at the 500 level or above.

<u>Course Titles:</u>
EECS 411	Microwave Circuits I
EECS 430	Radiowave Propagation and Link Design
EECS 503	Introduction to Numerical Electromagnetics
EECS 517	Physical Processes in Plasmas
EECS 519	Plasma Generation and Diagnostics Laboratory
EECS 525	Advanced Solid-State Microwave Circuits
EECS 530	Electromagnetic Theory I
EECS 531	Antenna Theory and Design
EECS 532	Microwave Remote Sensing I: Radiometry
EECS 533	Microwave Measurements Laboratory
EECS 631	Electromagnetic Scattering
EECS 632	Microwave Remote Sensing II: Radar
EECS 633	Numerical Methods in Electromagnetics

12.7 Optics and Photonics

<u>Minor:</u>
For MS Degree: Two courses from the list below, including one at the 500 level and above.

For CANDIDACY: At least three courses from the list below, with two or more courses at the 500 level or above.

<u>Course Titles:</u>
EECS 434	Principles of Photonics
EECS 435	Fourier Optics
EECS 438	Advanced Lasers and Optics Laboratory
EECS 530	Electromagnetic Theory I
EECS 535	Optical Information Processing
EECS 536	Classical Statistical Optics
EECS 537	Classical Optics
EECS 538	Optical Waves in Crystals
EECS 539	Lasers
EECS 540	Applied Quantum Mechanics I
EECS 546	Ultrafast Optics
EECS 552	Fiber Optical Communications
EECS 634	Nonlinear Optics
EECS 638	Quantum Theory of Light

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12.9 Solid-state

<u>Minor:</u>
For MS Degree: At least two courses from the list below, including one at the 500 level or above, not more than one two-hour laboratory course.

For CANDIDACY: At least three courses from the list below, including at least two at the 500 level or above, and not more than one two-hour laboratory course.

<u>Course Titles:</u>
EECS 420   Physical Principles Underlying Smart Devices
EECS 421   Properties of Transistors
EECS 423   Solid-State Device Laboratory
EECS 425   Integrated Microsystems Laboratory
EECS 429   Semiconductor Optoelectronics Devices
EECS 512   Amorphous and Microcrystalline Semiconductor Thin Film Devices
EECS 513   Flat Panel Displays
EECS 517   Physical Processes in Plasmas
EECS 520   Electronic and Optical Properties of Semiconductors
EECS 521   High-Speed Transistors
EECS 523   Digital Integrated Technology
EECS 525   Solid State Microwave Circuits
EECS 528   Principles of Microelectronics Process Technology
EECS 529   Semiconductor Lasers and LEDs
EECS 540   Applied Quantum Mechanics I

13. COGNATES COURSES

The Graduate School requires that graduate student to complete cognate courses, which are courses in a discipline or area different from a student's field of study, but are related or connected with some aspect of this field.

A general rule is that your cognate courses should be courses outside the ECE program. So courses that count towards any of the ECE major areas **should not** be used as a cognate. Use the EECS course list to determine whether an EECS course can be used as a cognate.

If you would like to use a course in a different ECE major area, you can ask for permission from your academic advisor. Go to the ECE Graduate Program Office or website for a Petition Request instruction form.

Please Note: The Graduate School requires that you earn a B- or higher in your cognate course. Failure to earn a B- or higher will result in the course not counting towards the Graduate School requirement and can delay your graduation.

EE:Systems PhD Plan of Study

Name (Print)　John Doe

Email:　jdoe@umich.edu　　　　UMID:　12345678

Major:　Control　　　Minor:　Signal Processing　　　Relevant MS degree: ☐ Yes ☑ No

Academic Advisor Signature: _____　　Date: 09.07.2015

COURSE #	TERM	# Credits	Grade	# Cr. Major	# Cr. Minor	# Cr. Cognate	# Cr. Res/Sem	# Cr. Other
Note: MARK COURSES GRANTED EQUIVALENCY AS EQ. EQ = 0 CR. HRS.								
EECS 1234	W13	3	A	3				
EECS 2345	F14	4	A-		4			
EECS 3456	W15	3	A	3				
EECS 4567	W15	3	B+		3			
EECS 5678	F15	3	A	3				
EECS 6789	F15	3	A-		3			
EECS 7890	F14	3	A	3				
EECS 6543	F14	3	B+	3				
MATH 9876	W15	3	A+			3		
MATH 8765	F15	3	A			3		
EECS 7654	W13	3	B	3				
EECS 6543	SS14	4	S				4	
COURSE TOTALS (credits or equivalency)	TOTAL ≥36 cr			Major ≥18 cr	Minor ≥9 cr	Cognate ≥4 cr	Res/Sem ≥4 cr	Other
	38			18	10	6	4	
500 level or higher EECS Courses	≥12 cr			≥6 cr	≥3 cr			
	15			12	3			
Graded Technical Courses (credits or equivalency)	≥24 cr							
	34							

See below for EE:S major/minor course requirement list.

-- All courses must be graduate level.

-- Cognate classes must be approved for graduate credit by Rackham & academic advisor.
Must be graded (not S/U).
Cognate is in addition to any classes taken for major/minor.

-- A maximum of 4 credits of "S" graded courses (individual study, research, seminars) may be counted.

-- Math 404, 417, 425, 448, 450 or their cross-listed classes may NOT be counted for any MS degree requirement.

-- Rack 998, CPT credit may NOT be counted for any MS degree requirement.

-- All courses grades must be ≥ B-.

--CUM GPA must be ≥3.0.

--If minor outside EECS, ≥ 3 cr. must be 500 level or higher

-- It is the student's responsibility to see that all Rackham and EE:S Program requirements are met.

*
After Graduation Plans_____

CANDIDACY CHECKLIST:

____ Min 36 cr (at least 1/2 fr Rack.)	____ ≤4 cr Research/Seminar	____ No grades below B-
____ 12 cr EECS 500 level	____ ≥4cr Cognate	____ Minimum 3.0 GPA
____ 6 courses in major	____ Passed Quals 2 Exam	
____ 3 courses in minor	____ Precandidate status at Rackham	

Term: _____

Approved: _____

6/2013

updated 06/2015