ROBOTICS GRADUATE PROGRAM MANUAL

Effective for students starting
Fall 2017
or later

SPACE RESEARCH BUILDING
2455 Hayward St, Ann Arbor, MI 48109
https://robotics.umich.edu/
# Table of Contents

1. **Introduction**  
2. **Admission**  
3. **General Academic Policies**  
   - Cognate Course Requirement  
   - Course Withdrawal  
   - Dual Degree and Certificate Programs  
   - English Proficiency  
   - Enrollment Status  
   - Grades and GPA Requirement  
   - Graduation  
   - Honor Code  
   - International Students  
4. **Master's Degree Requirements**  
   - Master's Degree Credit Distribution/Coursework  
   - Master's Degree Plan of Study  
   - Transfer of Credit  
   - Applying to Ph.D. Program  
5. **Ph.D. Degree Requirements**  
   - Relevant Master's Degree  
   - Embedded Master's Degree  
   - Ph.D. Degree Credit Distribution/Coursework  
   - Ph.D. Degree Plan of Study  
   - Course Equivalency  
   - Annual Progress Report/Financial Support  
   - Ph.D. Degree Deadlines  
   - Ph.D. Degree Timeline  
   - Qualification Examination  
   - Candidacy  
   - Research Thesis Proposal  
   - Dissertation Defense  
6. **Student Handbooks and Internet Resources**
1. INTRODUCTION

Michigan Robotics offers Master’s and Ph.D. degrees. Both programs are built on a common set of course requirements, with Ph.D. students also completing research published in leading journals in the field of robotics.

The Michigan Robotics program consists of three main technical areas, which converge as students produce functioning robots:

- Sensing of the environment, external agents, and internal body information to determine state information
- Reasoning with that information to make decisions for guidance, control, and localization
- Acting upon the body and environment to produce motion or other outputs that enable the robot to locomote or interact with the environment

Each of these areas may be considered a subplan for coursework and research study.

Our students come to the field with a variety of backgrounds, particularly in mechanical engineering, electrical engineering, and computer science. They learn to work in teams to accomplish the many tasks necessary to build and operate an autonomous system, including mechanical design, electronics, programming and integrating all the parts. Students graduate the program as independent researchers and engineers, and many will go on to become leaders in robotics research, in academia, industry and government.
2. ADMISSION

Admission to the Robotics Graduate programs is through the Rackham Graduate School. Please click here for additional information regarding applying: 
https://robotics.umich.edu/academic-program/program-description/admissions-info/

It is the responsibility of the applicant to make sure the Robotics Graduate Program receives the completed application form by the specified deadlines.

Students desiring admission to the Master’s and Ph.D. Program should have earned a bachelor's degree in engineering, mathematics, or physical sciences. Admission to the Master’s and Ph.D. Program requires a completed application, transcripts of all previous academic records, three letters of recommendation, GRE scores, academic statement of purpose, and personal statement.

Ph.D. students admitted without a master’s degree may complete the master’s requirements as they progress through the Ph.D. Program.

Current UM graduate students in other programs may be eligible to earn a dual degree in Robotics. Adding an additional Robotics Master's degree requires a completed “Add a Degree” application, a letter of recommendation from research advisor, UM transcript, and Master’s degree plan of study. Go to the Robotics Graduate Program Office or website for additional information.

3. GENERAL ACADEMIC POLICIES

Cognate Course Requirement

The Rackham Graduate School requires Ph.D. students and Master's students admitted prior to Fall 2018 to complete coursework outside of their major research/interest area. Master’s students admitted Fall 2018 or later are not required to fulfill the cognate requirement. Should a Master’s degree student continue into the Ph.D. program the cognate requirement will need to be fulfilled. The Robotics Institute requires students to complete at least four credits (typically two courses) to meet this requirement. Only letter graded graduate level courses may be used to meet this cognate requirement.

Any graduate level course outside of the Robotics Institute meets this requirement. Also, cross-listed courses within the Robotics Institute are allowable unless they are already part of the student's core area. Academic/research advisor approval is required for any course that is not within the two previously stated categories.
Course Withdrawal

Courses dropped after the 3rd week registration period will receive a “W” on transcript.

After the eighth week of a full term (fourth week of a half term), courses may be dropped until the last day of the term or changed to Visit/Audit status only under exceptional circumstances and with the approval of the course instructor, and advisor.

You cannot remove courses from your transcript.

Term specific deadline dates are posted on the registrar's website.

Dual Degree and Certificate Programs

Robotics students have the ability to obtain master's degrees or graduate certificates in other programs at U-M. Adding a master’s degree or graduate certificate may require additional coursework and semesters to a student's time at U-M. In addition, there is a limit to how many courses can be counted towards the original master's degree and the added master's degree or graduate certificate. Adding a graduate certificates can only be done if the student is currently enrolled in a Master's or Ph.D. program.

Students interested in pursuing this options must contact the graduate program of interest to find out the requirements to add the degree.

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 Ph.D. student participates in the oral Qualifying Exams and Research Thesis Proposal presentation. If the faculty considers the student to otherwise be qualified for the Robotics Ph.D. program, it may be recommended that the student take English courses. Students with major deficiencies in English will be found Not Qualified for the Robotics Ph.D. Program.
**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, student’s account is charged an amount for each credit hour.

For 9+ credits, student’s account is charged a single amount for all the credits.

**Grades and GPA Requirement**

All grades are on the Rackham Graduate School scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>4.3</td>
</tr>
<tr>
<td>A</td>
<td>4.0</td>
</tr>
<tr>
<td>A-</td>
<td>3.7</td>
</tr>
<tr>
<td>B+</td>
<td>3.3</td>
</tr>
<tr>
<td>B</td>
<td>3.0</td>
</tr>
<tr>
<td>B-</td>
<td>2.7</td>
</tr>
<tr>
<td>C+</td>
<td>2.3</td>
</tr>
<tr>
<td>C</td>
<td>2.0</td>
</tr>
<tr>
<td>C-</td>
<td>1.7</td>
</tr>
<tr>
<td>D+</td>
<td>1.3</td>
</tr>
<tr>
<td>D</td>
<td>1.0</td>
</tr>
<tr>
<td>D-</td>
<td>0.7</td>
</tr>
</tbody>
</table>

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.

**Graduation**

Graduation for the Master’s or Ph.D. degree is not automatic. A student who has completed the degree requirements must 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).
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

International Students

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 Robotics website for the CPT instruction form and complete all necessary paperwork.

Credit for CPT (Rackham 998) may not be counted toward any ROB degree requirements.

Optional Practical Training (OPT) for F-1 Students

OPT is defined in the Federal Regulations as temporary employment directly related to a student's field of study. During OPT, a student remains in F-1 status. The end result of the OPT request process is an Employment Authorization Document (EAD) issued by United States Citizenship and Immigrations Services (USCIS).

Processing OPT applications typically requires 60 to 90 days.

Some STEM students may be eligible for a 17 month extension of OPT.

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 robotics 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. For further information: http://internationalcenter.umich.edu
4. MASTER’S DEGREE REQUIREMENTS

To receive a Robotics degree, a student must satisfy the Robotics 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.

Master's Degree Credit Distribution/Coursework

The Master's degree requires a minimum of 30 graduate level credit hours with the following distribution:

- ≥ 30 graduate level credit hours
  - 7 credits of ROB 550 and ROB 501
  - ≥ 12 credits of technical graded courses
    - ≥ 9 credits of sensing, acting, reasoning areas
    - ≥ 3 credits in “depth area”
  - ≥ 4 credits of graded cognate area (courses outside depth area and outside ROB; may count toward your technical course requirement)
  - ≤ 6 credits of directed study (ROB 590)

All course requirements must be letter-graded (A, B, etc.) and may not be marked as satisfactory/unsatisfactory except for the directed study requirements.

Technical courses are generally courses from Engineering, Math, Statistics, Physics, and other science disciplines. The academic advisor must approve courses from Economics, Business, etc.

Courses that do not count towards master’s degree requirements:

- Courses with number 990, 995 or other course with “doctoral,” “dissertation,” or “preliminary” in the title may not be counted towards master’s degree requirements.
- Rackham 998 (Curricular Practical Training) may not be counted for any degree requirements.
- ELI courses cannot count towards degree requirements.
- Courses with insufficiently advanced content and level, or which substantially duplicate in content and level courses already completed by the student.

Master's Degree Plan of Study

*Please note that the master’s degree plan of study form is currently being updated and will be ready by the end of September*

The MS Plan of Study is a form that maps out which courses satisfy the specific degree requirements. It is required that students submit a plan of study, approved and signed by their corresponding Academic Advisors, at the beginning of the first term, within a month after the
beginning of their first semester. Failing to do so will risk the student’s ability to register the following semester.

It is also required that a student get pre-approval and signature from his/her Academic Advisor or the Graduate Coordinator on a revised Plan of Study each time he/she wishes to make changes to it. Failing to do so will risk the student’s ability to graduate with a Plan of Study that had not been pre-approved. It is highly recommended that students meet with their academic advisors to discuss the plan at the beginning of each term.

Please Note: It is the responsibility of the student to submit to the Robotics Graduate Program Coordinator an updated, signed final MS Plan of Study when applying for graduation. Failure to submit the MS Plan of Study timely could delay graduation.

**Master’s Degree Timeline**

The timeline below displays a "typical" Master’s student progress in our program in 3 or 4 semesters. Students must complete all work for the Master's 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.
<table>
<thead>
<tr>
<th>Academic Term</th>
<th>Coursework</th>
<th>Research Activities (optional)</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1: Fall</td>
<td>8-9 credits</td>
<td>Search for a research advisor</td>
<td>≥3.0 GPA</td>
</tr>
<tr>
<td>Year 1: Winter</td>
<td>8-10 credits</td>
<td>Choose research advisor for independent study</td>
<td>≥3.0 GPA</td>
</tr>
<tr>
<td>Year 1: Sp/Su</td>
<td></td>
<td>Independent study or Internship</td>
<td></td>
</tr>
<tr>
<td>Year 2: Fall</td>
<td>8-11 credits</td>
<td>Independent study</td>
<td>≥3.0 GPA; (Apply for graduation)</td>
</tr>
<tr>
<td>Year 2: Winter</td>
<td>3-6 credits</td>
<td>Independent study</td>
<td>≥3.0 GPA; (Apply for graduation)</td>
</tr>
</tbody>
</table>

**Transfer of Credit**

Students who want to transfer credits must follow the Rackham Transfer of Credit guidelines:

- A student is allowed to transfer up to 6 credits from external institutions or 15 credits can be transferred from within the University of Michigan.
- Credits must be transferred to a Master’s Program
- 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 have been used to satisfy degree requirements for undergraduate or graduate degree. (In other words, they must be extra credits taken)

**Applying to Ph.D. Program**

Current MS students interested in the Robotics Ph.D. program must apply by following the Rackham application process. Such students are strongly encouraged to get involved in research with a faculty prior to the application. Current MS students who apply to the Ph.D. program without having first formed a research relationship with a potential Ph.D. advisor are rarely admitted.
5. PH.D. DEGREE REQUIREMENTS

Relevant Master’s Degree

If a student entering the Ph.D. Program already has a Master’s degree, it is determined at the time of admission whether the Master’s degree coursework is sufficiently similar to the Robotics Master's degree requirements/coursework. If so, the coursework is deemed to be relevant.

Embedded Master’s Degree

Students who enter the Ph.D. Program without a relevant master’s degree are not automatically enrolled in the Robotics Master’s Program. To add the Master’s degree, students need to submit a final MS Plan of Study (approved and signed) to the Robotics Graduate Coordinator at the beginning of the semester in which the student will complete the master’s degree requirement.

Ph.D. Degree Credit Distribution/Coursework

1) **Without a relevant Master’s degree**, a student must complete a **minimum of 36 graduate level credit hours** with the following distribution:

- ≥ 36 graduate level credit hours
  - ≥ 30 graduate level credit hours
    - ≥ 7 credits of ROB 550 and ROB 501
    - ≥ 12 credits of technical graded courses
      - ≥ 9 credits of sensing, acting, reasoning areas
      - ≥ 3 credits in “depth area”
    - ≥ 4 credits of graded cognate area (courses outside depth area and outside ROB; may count toward your technical course requirement)
    - ≤ 6 credits of directed study (ROB 590)

2) **With a relevant Master’s degree**, a student must complete a **minimum of 18 graduate level credit hours** with the following distribution:

- ≥ 18 graduate level credit hours taken at UM Ann Arbor
  - ≥ 6 credits of graded technical courses
  - ≥ 4 credits of graded cognate courses
  - ≥ 6 credits of graduate level courses approved by the research advisor (including directed study)
Note:

- There is no additional “core area” requirement here for the extra 6 credits -- just advisor approval.
- Technical courses are generally courses from Engineering, Math, Statistics, Physics, and other science disciplines. The academic advisor must approve courses from Economics, Business, etc.

Courses that do not count towards Ph.D. degree requirements:

- Courses with number 990, 995 or other course with “doctoral,” “dissertation,” or “preliminary” in the title may not be counted towards master’s degree requirements.
- Rack 998 (Curricular Practical Training) may not be counted for any degree requirements.
- ELI courses cannot count towards degree requirements.
- Courses with insufficiently advanced content and level, or which substantially duplicate in content and level courses already completed by the student.

You must maintain a 3.5 GPA (on a 4.0 scale, A=4.0) and must make a grade of B+ or higher in all courses counted toward your robotics PhD.

**Ph.D. Degree Plan of Study**

Students develop a Ph.D. Plan of Study in conjunction with their academic or research advisor(s). The plan of study can be changed as the student progresses through the program. The Ph.D. Plan of Study must satisfy the following requirements and be approved by the student’s research advisor(s).

The Ph.D. Plan of Study must satisfy all Rackham coursework requirements (including GPA, residency, and cognate requirements). For further information:
http://www.rackham.umich.edu/current-students/policies/academic-policies/section5-51

**Course Equivalency**

If a student has taken a course elsewhere that is “substantially equivalent” to a Robotics course, it may not be necessary to retake the course. The student should consult with their academic and/or research advisor at the earliest opportunity to determine whether or not equivalency is appropriate.

Students entering with a Master’s degree must submit a review request to the graduate coordinator and Graduate Chair as part of the planning and advising process at the beginning of their first term in the graduate program.

For course equivalency approval, additional supporting documentation is required such as syllabus, course description, homework, etc.
Annual Progress Report/Financial Support

Continued enrollment and guaranteed financial support is contingent upon satisfactory academic and research progress by the student.

Student evaluations are conducted annually at the end of the winter semester with a due date of May 31st. The student and his/her research advisor will complete and sign the Annual Progress Report.

This report will identify one of three possible outcomes:
- Satisfactory
- Concerns
- Unsatisfactory

Submission of the annual report is mandatory. Failure to submit the Annual Progress Report may lead to a rating of ‘Unsatisfactory’. Lack of satisfactory progress may lead to the termination of the guarantee of financial support and to the student’s discontinuation from the graduate program.

When a student’s progress is deemed to be of ‘Concerns’ or ‘Unsatisfactory’, an interim Progress Reports will have to be submitted. At these times, the student’s overall progress will be re-evaluated. The Graduate Program Chair may also request submission of an interim Progress Report prior to the April annual evaluation.

A student with guaranteed financial support will be told in writing at least two months before his/her tuition, stipend and health insurance actually ends. If the stipend is terminated during a term in which the student is enrolled, financial obligations (tuition & fees, stipend, and health insurance) will be covered until the end of the term.
## Ph.D. Degree Deadlines

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Enter without relevant Master's</th>
<th>Enter with relevant Master's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master's degree coursework</td>
<td>4</td>
<td>N/A</td>
</tr>
<tr>
<td>Ph.D. degree coursework</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Qualification Exams</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Candidacy</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Thesis Proposal</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Thesis Defense</td>
<td>9 - 12</td>
<td>7 - 10</td>
</tr>
</tbody>
</table>

A student may be given 4 additional months/1 term to complete each milestone with approval from their Research Advisor and the Graduate Program Chair.

Students must complete any remaining credits after achieving Candidacy and prior to giving their Thesis Proposal.

### Ph.D. Degree Timeline

Below is the typical timeline for the Ph.D. student. The Ph.D. is unique to each student due to the nature of research and is subject to greater flexibility in timing. Nevertheless, the Robotics Program expects the majority of students to complete the Ph.D. degree in no more than five years. Students who take longer than five years to complete the Ph.D. degree may lose departmental financial support.

The Rackham Graduate School allows up to 7 years from the first term of enrollment. Students who do not complete the Ph.D. degree in 7 years must submit a petition to Rackham requesting an extension.

<table>
<thead>
<tr>
<th>Academic Term</th>
<th>Coursework</th>
<th>Research Activities</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1: Fall</td>
<td>2-3 courses</td>
<td>Departmental and area research seminars, Faculty/student research meetings</td>
<td>≥3.0 GPA</td>
</tr>
<tr>
<td>Year 1: Winter</td>
<td>2-4 courses, Prepare for Qualifying Exam #1</td>
<td>Departmental and area research seminars, Faculty/student research meetings</td>
<td>≥3.0 GPA</td>
</tr>
<tr>
<td>Year 1: Sp/Su</td>
<td></td>
<td>Identify a topic for Qual research project,</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Courses</td>
<td>Research Activities</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Year 2: Fall</td>
<td>2-3 courses Directed research</td>
<td>Faculty/student research meetings in area of interest, directed research with research advisor</td>
<td>begin preliminary readings and a preliminary problem statement</td>
</tr>
<tr>
<td>Year 2: Winter</td>
<td>2-3 courses + directed research, take Qual Exam #2</td>
<td></td>
<td>&gt;3.0 GPA, refine the problem statement and begin research, Complete Qualifying Exam #1</td>
</tr>
<tr>
<td>Year 2: Sp/Su</td>
<td></td>
<td></td>
<td>Continue/begin research for Thesis Proposal</td>
</tr>
<tr>
<td>Year 3: Fall</td>
<td>ROB 995 + 1 course (max), if already a candidate</td>
<td>Research with research advisor, faculty/student research meetings in other areas of interest</td>
<td>Problem formulation, preliminary readings and derivations for Ph.D. Thesis Proposal</td>
</tr>
<tr>
<td>Year 3: Winter</td>
<td>ROB 995 + 1 course (max)</td>
<td>Research with research advisor, faculty/student research meetings in other areas of interest</td>
<td>Problem statement, refinement, form dissertation committee and present a Thesis Proposal</td>
</tr>
<tr>
<td>Year 3: Sp/Su</td>
<td></td>
<td></td>
<td>Ph.D. research</td>
</tr>
<tr>
<td>Year 4: Fall</td>
<td>ROB + 1 course (max)</td>
<td>Ph.D. research</td>
<td>Update dissertation committee on research progress (at least once during the academic year)</td>
</tr>
<tr>
<td>Year 4: Winter</td>
<td>ROB 995 + 1 course (max)</td>
<td>Ph.D. research</td>
<td>Update dissertation committee on research progress (at least once during the academic year)</td>
</tr>
<tr>
<td>Year 4: Sp/Su</td>
<td></td>
<td></td>
<td>Ph.D. research</td>
</tr>
<tr>
<td>Year 5: Fall</td>
<td>ROB 995 + 1 course (max)</td>
<td>Ph.D. research</td>
<td>Update dissertation committee on research progress</td>
</tr>
<tr>
<td>Year 5: Winter</td>
<td>ROB 995 + 1 course (max)</td>
<td>Ph.D. research</td>
<td>Final defense of dissertation before dissertation committee, complete any dissertation revisions, graduate with Ph.D.</td>
</tr>
</tbody>
</table>
Qualification Examination

A major milestone for Ph.D. students is to pass the qualifying/preliminary exams, which along with required coursework completion advances the student to Ph.D. candidate status. The qualification process is comprised of a review of academic performance, a technical (coursework-based) qualifying exam, and a research-based preliminary exam. A Ph.D. student is considered to have adequate performance in coursework if his/her grade-point average is 3.5 or above. Both components of the exam are typically completed after either three or four semesters in the program. Once required Ph.D. coursework and both preliminary exam components have been successfully completed, a Robotics Ph.D. student is encouraged to apply for Ph.D. candidacy. Specifics and instructions for each exam are provided below.

Part 1: Technical (Coursework-based) Qualifying Exam

The technical qualifying exam is typically taken by students approaching the end of their second semester in the Robotics Ph.D. program. It is expected that all Robotics students will complete the technical qualifying exam no later than the end of a student’s third semester in the Robotics Ph.D. program. Each student is eligible for a maximum of one exam re-take if needed. The qualifying exam is offered twice per year, once in December and once in April/May.

Qualifying exam questions will be based upon content in ROB 501 and ROB 550. The qualifier is an oral exam in which the student is examined by two faculty members from the robotics program. Neither qualifying examination faculty member will be the student’s advisor or co-advisor; the examining faculty will be assigned by the graduate committee soon after the student submits a “qualifying exam request” as stipulated below. The faculty committee will examine the student’s understanding of technical fundamentals by asking a combination of conceptual and problem-solving questions. The student is expected to share their thoughts as they solve each problem, using the examination room whiteboard to write down pertinent concepts, derivations/calculations, and solutions. It is common for examiners to give “hints” periodically - students are highly encouraged to ask examiners for clarification and listen carefully to guidance. If a concept is not familiar, make sure you share this with the examiner so he/she can explain further. While we expect students to demonstrate robotics problem-solving skills, we do not expect perfect recall of facts.

Coursework-based qualifying exam procedure:

A student must have selected a primary advisor and a co-advisor (for fellowship students) prior to signing up for the qualifying exam. GSRA students only require a primary advisor. The student is responsible for securing approval to take the exam from his/her advisor (and co-advisor for fellowship students). The student must indicate his/her intention to take the qualifying exam upon receiving the qualifying examination instruction email from the grad coordinator mid-semester. In indicating their intention to take the exam they must include:

- Student’s advisor
• Student’s co-advisor (required for all fellowship students)
• Student’s updated unofficial transcript showing courses taken and courses in which student is currently enrolled.
• One-sentence summary of the student’s independent study research area.

The graduate committee will assign two examination faculty to each student. The student is expected to coordinate a two-hour exam day/time block with examination committee members. Students should feel free to email their examiners to ask for advice; specifics of this correspondence will be left to the discretion of the examiners. Examiners will be asked to rate the student based on their level of mastery in each course as well as overall ability to think and communicate with the examiners.

Once the exam has been completed, the examiners will return their evaluations to the graduate committee. The graduate committee will present examination results to the robotics faculty who will collectively determine the exam outcome for each student.

**Part 2: Research-based Qualifying or Preliminary Exam**

The Research-based (Part 2) Qualifying Exam is typically taken the term after the Coursework-based (Part 1) qualifying exam to test the student’s ability to conduct independent research at the Ph.D. level. There are four primary objectives: 1) Assess depth of knowledge in the area of research specialization and the ability to relate this to research, (2) Assess ability to propose an interesting and relevant problem for Ph.D. research, (3) Test ingenuity, creativity, and problem-solving skills, and (4) Assess written and oral communication skills and the ability to respond to questions.

**Format and Timeline:** The research preliminary exam is typically taken the semester after the student successfully completes the technical qualifying exam. Exams are typically held in December (fall) and April/May (winter). The scheduled oral exam lasts for 90 minutes structured as a 30 minute presentation with up to 60 minutes of question and answer by two robotics faculty members. This exam will be scheduled for a 1.5 hour window.

Registration: Eligible students must register their intent to take the exam with both the Graduate Program Chair and Graduate Coordinator as an email response to the qualifying exam instructions sent out mid-semester. In this email, the students must submit the following: (1) A bio-sketch using the NSF Fellowship application format, (2) A research paper title and 150-200 word abstract, (3) A list of courses taken with discussion of how the courses match the research prelim exam topic and future research plans (less than 200 words), and (4) Recommendations of any (up to three) robotics faculty members the student would like to serve as examiners; note that neither the student’s advisor nor co-advisor are eligible to serve as examiners. See http://robotics.umich.edu/faculty/ for a list of eligible robotics faculty, (5) An email from the advisor indicating they agree to the student’s participation in this exam for the given term. Any deviation from timely production of any of these documents should be discussed and approved in advance by the Graduate Program Chair.
Each student registered for the Part 2 exam must email Prof. Atkins and the Grad Coordinator a standard IEEE conference paper format document describing the research (no more than 8 pages; see http://www.ieee.org/conferences_events/conferences/publishing/templates.html for format details).

Faculty examiners will be selected by the graduate committee based on consideration of student input and faculty availability constraints, the student is responsible for coordinating an examination date and time with the faculty examiners and returning this information to Prof. Atkins at least two weeks before the exam date. As with the qualifying examination, a conference room will be reserved.

**Important:** The student should correspond with faculty examiners by email and/or in person prior to the exam to ensure presentation and preparation expectations are clear, and then the student should prepare the research presentations based on a combination of inputs from the advisor, co-advisor, and examination committee. Students should prepare a presentation to last approximately 30 minutes without questions. Examiners are at liberty to ask questions before, during, and after the presentation.

**Grading:** Students are evaluated on a scale ranging from poor to excellent (0-4 point scale) in each of the following areas as described in more detail on the attached examiner grading sheet.
- Synthesis of course material for the student’s research problem.
- Student input to the research project.
- Research conduct and methodology.
- Research outcomes.
- Written and oral communication: content, clarity, ability to answer questions.
Scores will be assigned by each faculty examiner along with comments. The examiners, advisor, and graduate committee will meet to make a final decision based on feedback from examiners and advisors.

**Communication of Results:** The result of the research qualifying exam is communicated by the Graduate Chair to the student through an individual email the day the final decision is made, typically the first day the robotics graduate committee or full faculty can meet following exam completion. Students will not receive numerical results but will receive written comments from both the examiners and the graduate chair regarding the final decision.

**Retaking the Research-based Qualifying Exam:** A student who fails the research-based qualifying exam on the first try must obtain approval from their advisor to retake the exam and must then email Prof. Atkins with this confirmation. Only one Part 2 exam retake is permitted. This exam retake must be completed no later than the next offering of the exam, typically the term after the first research-based exam attempt. If the student does not receive support from the current advisor, the student must choose a new advisor who formally agrees to support the student for the exam retake and for the duration of the student’s studies.
**Candidacy**

Completing the coursework required for Candidacy status 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.

**Requirements**

1) Satisfy the following coursework requirements:
   a) Have completed the 18 letter graded graduate course requirement (note 6 credits of directed study grade ‘S’ is allowed)
      a. 4 credits of the 18 credits must be cognate
2) Pass the Qualifying exams.
3) Satisfy all Rackham candidacy requirements (including GPA, residency, etc.). Click here for further details:
   [http://www.rackham.umich.edu/current-students/policies/academic-policies/section5#51](http://www.rackham.umich.edu/current-students/policies/academic-policies/section5#51)
4) Candidacy is not automatic; once all Robotics and Rackham requirements are met, a student must apply for candidacy by contacting the Graduate Program Coordinator.
5) Complete the College of Engineering’s Responsible Conduct of Research and Scholarship program. This program consists of 4 distinct workshops, all 4 workshops must be completed. For further information and to register for workshops: [http://rcrs.engin.umich.edu](http://rcrs.engin.umich.edu)

**Course Enrollment**

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

In addition to ROB 995, Candidates may elect either one course per term or more than one course for a total of no more than four credits without paying additional tuition beyond candidacy tuition. Courses may be taken for credit or as a visit (audit). A candidate who does not elect a course during a term of 995 enrollment may, in the next term, either register for courses for no more than 8 credits or register for no more than two courses that total more than 8 credits. 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 will be assessed additional tuition per credit hour. For more information please see the [Rackham Academic Policies](http://www.rackham.umich.edu/current-students/policies/academic-policies/section5#51).

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.
Research Thesis Proposal

After passing the Qualifying Exam, a student continues to work with his/her Research Advisor who becomes the Dissertation Committee Chair(s). The student will write a concise Research Thesis Proposal and give a formal oral presentation of the work to the Dissertation Committee. The Dissertation Chair(s) primary role is to guide the student toward completion of the Ph.D. and assists the student with forming their Dissertation Committee.

When the student is ready to complete the Research Thesis Proposal, the student must complete the following:

1. Schedule an oral presentation with the Dissertation Committee.
2. Submit the written thesis proposal to the Dissertation 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 utilized.

During and after the Thesis Proposal presentation, the Dissertation Committee will explore the proposed research with the student in order to provide guidance and make an evaluation of 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 oral presentation to the committee. If the proposal is not acceptable, the student has twelve months to prepare and present a satisfactory proposal.

Students entering the Ph.D. Program without a relevant Master’s degree must write and orally present the Research Thesis Proposal within 36 months of entry. Students entering with a relevant Master’s degree must present within 30 months.

Dissertation Defense

In collaboration with the Dissertation Chair(s), the student forms a Dissertation Committee following specific guidelines regarding the composition of the Committee. A Robotics Ph.D. student’s dissertation committee first must satisfy Rackham’s Guidelines for Dissertation Committees:
http://www.rackham.umich.edu/current-students/dissertation/committees

Dissertation Committee formation rules
The following rules apply to students in the Robotics Ph.D. program:

1. The committee must consist of four or more members; at least two of the members must be affiliated with the Robotics program.
2. The Research Advisor (or Co-Advisors) will serve as Chair (or Co-Chairs) of the committee.
3. One of the Committee members must be designated as "cognate member." Cognate members must be a tenured-track faculty in a Rackham graduate program.
   a. Faculty with 0% affiliation in Robotics Core Area may serve as cognates for Robotics thesis committees.
4. The Robotics Graduate Program Chair must approve the thesis committee.

Dissertation Progress Reviews

Once the student has successfully presented the Research Thesis Proposal, the student should meet informally (or formally at the discretion of the Dissertation Chair). The student should meet with 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 Robotics Graduate Committee if the student is not making satisfactory progress. After two consecutive unsatisfactory progress reviews, the Robotics Graduate Committee may terminate the enrollment of the student.

Final Oral Defense

Each Ph.D. 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 Oral 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 Oral Defense to allow sufficient time for a written evaluation. The Final Oral Defense will only be held if the committee deems the dissertation acceptable. Once all members of the Dissertation Committee find the dissertation acceptable, the Final Oral Defense is held.

Course Enrollment

The student must be enrolled in 8 hours of ROB 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.

Timing/Grace Period

Rackham allows several additional weeks beyond the end of each semester for Ph.D. students to complete all of the doctoral degree requirements. This additional time is known as the Grace
Period. The Grace Period enables the student to complete their work without needing to register for the new semester. However, the degree is still awarded at the end of the new semester.

Please click for further details:
http://www.rackham.umich.edu/current-students/policies(doctoral/Ph.D.-students/doctoral-degree-deadlines
9. STUDENT HANDBOOKS AND INTERNET RESOURCES

The Rackham Graduate School Student Handbook and the Engineering College Bulletin are among the numerous U-M publication available online. The Rackham Handbook gives details about the graduate degree requirements imposed by the Graduate School, and should be consulted by all graduate students. Some important topics include the continuous enrollment policy and fees.

Rackham Graduate School: http://www.rackham.umich.edu
College of Engineering: http://www.engin.umich.edu/college/

U-M Wolverine Access: https://wolverineaccess.umich.edu/
U-M Registrar: http://ro.umich.edu
Student Financial Services: http://www.finance.umich.edu/finops/student
U-M International Center: internationalcenter.umich.edu

CoE Honor Code: http://ossa.engin.umich.edu/honor-council/
Student Rights and Responsibilities: https://oscr.umich.edu/article/statement-student-rights-and-responsibilities-1