

**University of Michigan Robotics PhD Program
Comprehensive Qualifying Exam (CQE)
Requirements and Instructions**

Contacts:

Graduate Program Chair, Prof. Brent Gillespie (brentg@umich.edu) or
Graduate Coordinator, Denise Edmund (grad-robotics@umich.edu)

A major milestone for PhD students is to pass the Comprehensive Qualifying Exam (CQE). Passing the CQE, along with required coursework completion, advances the student to PhD candidate status. A PhD student is considered to have adequate performance in coursework if their cumulative grade-point average is 3.5 or above.

The CQE will typically be taken by students approaching the end of their third semester in the Robotics PhD program, but it is expected that all Robotics students will complete the CQE no later than the end of their fourth semester in the Robotics PhD program. If entering with a relevant master's degree the CQE should be completed by the end of a student's third semester. Taking the exam in the second semester is contingent on having taken 2 courses from the sensing/acting/reasoning lists or prior MS courses counting toward these requirements. See the Course Equivalency section of the Grad Program Manual for details. Each student is eligible for a maximum of one exam retake if needed. The qualifying exam is offered twice per year, once in November/December and once in April/May.

A student automatically qualifies to take the CQE if they received a grade of A- or better in both ROB 501 and ROB 550. A grade of B+ in either ROB 501 or ROB 550 is considered a borderline case and the student must request permission to take the CQE by identifying their core weaknesses and a plan (approved by advisor) to address them (e.g. by taking an independent study or related class, or retaking core class). This proposal will be considered by the Graduate Committee. If the student receives a grade below B+ in ROB 501 or ROB 550 they need to retake the course(s). Only one retake per class is allowed.

The CQE 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 sign-up deadline. 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. Examiners will take turns asking questions and are at liberty to ask questions before, during, and after the presentation.

There are five primary objectives of the CQE: 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 PhD research, (3) Test ingenuity, creativity, and problem-solving skills, (4) Assess written and oral communication skills and the ability to respond to questions, and (5) Assess technical understanding of core course concepts, especially those related to the research area.

Process:

1. The student is responsible for securing approval to take the exam from their advisor(s) and the advisor(s) must email their approval to the Grad Coordinator.
2. The student must indicate their intention to take the CQE by the deadline indicated in the announcement email sent by the Grad Coordinator. For Winter 2023, the email sign-up deadline is **Monday, April 10**. Each Robotics PhD student intending to take the qualifying exam must email the following information to the Robotics Graduate Coordinator on or before this deadline. Any deviation from timely production of any of these documents should be discussed and approved in advance by the Graduate Program Chair.
 - a. Student's name
 - b. Name of advisor(s)
 - c. A bio-sketch using the [NSF Fellowship application format](#)
 - d. A research paper title and 150-200 word abstract

- e. 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),
 - f. Recommendations of any (up to three) robotics faculty members the student would like to serve as examiners; note that the student's advisor(s) are not eligible to serve as examiners,
 - g. Recommendations of any (up to three) robotics faculty members the student would prefer *not* serve as examiners. See <http://robotics.umich.edu/faculty/> for a list of eligible robotics faculty.
3. By **Monday, May 1**, each student registered for the CQE must email the Robotics Grad Coordinator a standard IEEE conference paper format document describing the research (no more than 8 pages* (including references); see [here](#) for format details). Faculty examiners will be selected by the graduate committee based on consideration of student input and faculty availability constraints.

*For students who have contributed to a project jointly with other students (*i.e.* co-authors on the conference paper style manuscript): You need to make clear your specific contributions to the project. Submit an additional page with 1-2 paragraphs (half page maximum) that articulates your contributions to the work. Clearly state what aspects of the project conceptualization, data collection, analysis, and writing were your responsibility. These paragraphs should reference sections of the manuscript that were written solely by you, detailing your work. You may reference the sections in the manuscript either by using subheadings, or by highlighting the specific sections in the manuscript in yellow. This is a qualifying exam, so each student must demonstrate individual research contributions to pass.

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.

1. Synthesis of Course Material in Research Problem Context
2. Input to Research Project
3. Research Conduct and Methodology
4. Research Outcomes
5. Written and oral communication: content, clarity, ability to answer questions

Exam Period: For Winter 2023, the CQE will be held between **Monday, May 8-Thursday, May 18**. Please alert Prof. Gillespie and Denise Edmund ASAP if you hope to take the exam but anticipate being unavailable throughout this examination period. After the exam scores will be assigned by each faculty examiner along with comments and the examiners will return their evaluation sheets to the Graduate Coordinator. **On May 19** the Graduate Chair will present examination results to the robotics faculty who will collectively determine the exam outcome for each student.

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 day after the exam period ends. 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 CQE: A student who fails the CQE on the first try must obtain approval from their advisor(s) to retake the exam and must then email the Graduate Chair and Graduate Coordinator with this confirmation. Only one 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 exam attempt. If the student does not receive support from the current advisor(s), 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.

Questions? Please email Prof. Gillespie or Denise Edmund if you have any questions about the above process. The Robotics Program graduate committee looks forward to working with you as you continue your PhD studies.

Unofficial advice to qual takers: (general philosophy - specifics differ from the Michigan Robotics qual):

<https://gradstudies.sf.ucdavis.edu/acing-your-qualifying-examination>

How to Prepare: The most important thing is to conduct rigorous research in the semester(s) before the CQE, and effectively present your research in the paper and oral talk. Closer to the exam, review your ROB 501 and ROB 550 notes and think about connections of course concepts to your research. These are the topics that the examiners are most likely to bring up after your research presentation. Think carefully about the “fundamentals” of robotics, especially your research topic, in terms of basic math, logic, and hands-on experiences you may have gained over your years as a K-12 and university student. Work toward a deep understanding of these foundational concepts. Form a study group to practice your research presentation and subsequent Q&A, including related technical questions from ROB 501/550. Ask more senior Robotics PhD students to serve as “examiners” in practice sessions at least a couple of weeks prior to the exam and reflect on their feedback. During the actual exam, listen to the faculty examiners as they will try to steer you in the right direction if you stray. Finally, it is very important to stay nourished and get plenty of sleep in the days leading up to the exam. It is better to be well-rested with a clear mind than to engage in last-minute cramming.
