2026 – 2027
PhD in Robotics
GRADUATE HANDBOOK

GEORGIA INSTITUTE of TECHNOLOGY

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Robotics PhD Handbook

I. Table of Contents

II. Purpose of this handbook

III. PhD Program in Robotics

IV. Admissions

1. Transfer Admissions

2. New Student Orientation

V. Academic Advising

VI. Home Unit and Home Unit Requirements

VII. Teaching Apprenticeship and Extra-Curricular Requirements

VIII. Course Requirements

a) RCR

b) Minor Field of Study

2. Program of Study

a) Qualifying Exam

b) PhD Candidacy

(1) PhD Thesis Proposal Process

- Advisory Committee
- PhD Proposal

(2) Thesis Defense

(3) Additional requirements for Thesis Proposal and Defense

- Announcements
- Institute Thesis Forms

IX. Online Application for Graduation (OAG)

X. Last Semester Registration Options

XI. Administrative Matters

XII. Financial Support

XIII. Registration

XIV. Course Transfer Credit/Course Waivers

XV. MS on the way
XVI. Graduate Internship Program
XVII. Appendix
XVIII. Administration and Governance
XIX. Information, forms, and Links
XX. Robotics PhD Program Home Units
1. Core Area Course Listings
2. Health and Wellness Resources

Purpose of this Handbook

The purpose of this handbook is to familiarize Robotics graduate students with degree program requirements, policies, procedures, and the resources available to students, and is intended to be a supplement to the General Catalogs, Student Handbooks of Georgia Tech, and academic departments. The info here does not replace nor supersede the materials in those resources.

As Robotics is an interdisciplinary program, students are responsible for understanding the policies and procedures for both their major programs and their home department in addition to the General Catalogs. The home department has ultimate decision-making responsibility for students assigned to their "home school."

Although students are encouraged to seek advice from the Robotics Program Director, faculty advisors, home departments, Academic Program Manager, the Georgia Tech Registrar's Office, Graduate Studies, and other resources on campus, it is ultimately the student's responsibility to know and meet the rules and regulations for degree completion. See the Appendix sections for additional various resources, including faculty and staff contact information and important websites.

PhD Program in Robotics

Offered jointly by the College of Computing and the College of Engineering, the Ph.D. program in Robotics is the first truly multidisciplinary robotics degree of its kind in the world—and only the second robotics doctorate offered in the U.S. The program involves the schools of Aerospace Engineering, Biomedical Engineering, Electrical & Computer Engineering, Interactive Computing, and Mechanical Engineering.

We educate a new generation of robotics researchers who are prepared to be impactful contributors upon entering the high-tech workforce. The Institute for Robotics & Intelligent Machines (IRIM) serves as the flagship for Tech's robotics efforts; therefore, IRIM has an integral relationship with the program, and many IRIM faculty members serve as research advisors to students pursuing the degree. The Robotics program supports Tech's mission to provide instruction in disciplines related to science, technology, and interdisciplinary areas.

Admissions

Final admission decisions will be made by the Robotics Program Faculty Committee in coordination with the home units. They are based on a combination of factors, including academic degrees and records, the statement of purpose, letters of recommendation, test scores, and relevant work experience. Also considered is the appropriateness of the applicant's goals to the Robotics Ph.D. Program, their expected abilities in carrying out original research, and the faculty research interests.

Applicants should select the home school that best aligns with their research interests and includes potential faculty advisors whose work they would be interested in pursuing. The Robotics Ph.D. curriculum is the same for each home school.

For questions regarding admissions, please contact school representatives of the Robotics Program Faculty Committee or the Program Director (see Personnel Info on this handbook).

Announcements and other important information are sent via the mailing list: phd-robo-official, so be sure to read these emails and mark them as safe in your inbox. All new students are added to this list before phase 2 registration.

Transfer Admissions

Students may be able to transfer into the Robotics PhD program if they are currently enrolled in another graduate program at Georgia Tech.

Submit the following items to the Robotics Program Director, Dr. Sam Coogan:

- Student cover letter/personal statement stating the reasons for transferring to Robotics.
- Current GT and undergraduate transcripts.
- A recommendation email letter from each the ROBO faculty advisor/co-advisor who are willing to support the student as a GRA.

Each transfer case is reviewed and voted on by the ROBO PhD committee. If approved, Change of Major Form will be completed by the student's current program and the Robotics Program Director. When submitting the Change of Major form, please be sure to CC the ROBO Program Manager, Chris Middleton. Note some home units may not allow internal transfers and students will be required to apply as an external application through GT Graduate Education.

New Student Orientation

There is a virtual information session each June for incoming Robotics PhD students before the fall semester begins with the ROBO Academic Program Manager. This session covers requirements, registration, and campus resources.

An orientation is hosted for all new Robotics PhD students the week before classes start in Mid-August. It will consist of a short presentation by the director on the degree requirements, and several events organized by the RoboGrads student organization and the Institute for Robotics and Intellligent Machines (IRIM). This will be in addition to the orientation the incoming students may have with their home schools and through the Institute.

GT Graduate Education Orientation: https://grad.gatech.edu/orientation-gradexpo

Academic Advising

For advice on which courses to take and when to take them, students should turn to their thesis advisor, the Program Director, representatives of the Robotics Program Faculty Committee, and RoboGrads (see personnel info on this handbook).

Advising on non-academic issues can be sought through the Robotics Program Manager including:

- Program and curriculum Advising
- General advising and CoC registration Info
- Institute policies and procedures
- Quals, proposal, and thesis defense information
- Course waiver requests/transfer credit requests
- Change of majors (including adding a MSCS degree)
- Minor form approvals (with faculty advisor signature)

Note the Robotics Program Manager may sign documents requiring a signature from the Robotics Graduate Coordinator, such as thesis and minor forms and internship forms.

Contact information for the Robotics Program Manager can be found in the Personnel Info section of this handbook.

Satisfactory Academic Progress Toward Degree Completion

Doctoral students should plan to complete their degree requirements in a timely manner and must complete the degree within seven years of passing the comprehensive exam as stated in Requirements for the Doctoral Degree. While the Admission to Candidacy should generally be completed within the first three years of entering the program, different degree programs may have specific timelines for which students must complete degree milestones. For Satisfactory Academic Progress, a student must be in good academic standing and meet at least one of the conditions listed here during an academic term in residence. Please view the GT catalog here (Section D.3) for the complete satisfactory academic progress rules and regulations, as students are required to adhere to this policy.

Research progress: Your thesis/research advisor is responsible for providing guidance on research completion. Effective communication is crucial for successful advisor/advisee relationships, fostering trust, understanding, and a supportive environment for the advisee's growth and development. Regular and open communication allows for a clear understanding of goals, expectations, and any challenges faced.

Individual Development Plans: The individual development plan (IDP) is a process designed to help individuals reflect on and plan their long-term career and academic goals. The aim is for graduate students to work with their advisors to collaboratively create a document that clearly identifies current goals in a way that resonates with the student's own long-term professional goals (informed by the advisor's expertise). https://ctl.gatech.edu/resources/best-practices/IDPs

Expectations of Advisors and Advisees

Please see Institute guidance on the expectations of advisors and advisees: https://catalog.gatech.edu/academics/graduate/expectations/.

A helpful guide for looking for advisors and mentors: How to Get the Mentoring You Want: A Guide for Graduate Students (from Univ. of Michigan).

Home Units and Home Unit Requirements

A home unit (or home school) is an academic unit (Department, Division, or School) at Georgia Tech that has agreed to formally participate in the Robotics programs. Each home unit has a representative on the Robotics Program Faculty Committee who is a faculty member in that unit. Students and the home unit must mutually agree on home unit affiliation. An initial home unit is determined during either the admissions process or in the process of transferring to a ROBO program from another PhD academic program at Georgia Tech. Once admitted, students may change to a new home unit if that unit agrees, which requires some paperwork to finalize the change, available through the ROBO Program Manager.

Each academic unit determines admission requirements (deadlines, GRE, etc), rules for allocation of space and financial assistance (e.g., teaching and research assistantships) for students applying to and who are homed in that unit. Home units may also have additional departmental requirements such as teaching apprenticeships (see more info below). Home units may also set specific requirements regarding registration for research and doctoral thesis hours. Check with the home unit directly for any specific requirements.

Ph.D. students' dissertation advisors should have an appointment in the same home unit or be a member of the ROBO programs faculty. Students are welcome to explore research opportunities with faculty in other units beyond the home unit. If a faculty member in another home unit becomes the advisor, the student may be given the option to change their home unit to that of their advisor's, per home unit policies.

Regardless of home unit, students must fulfill the Robotics degree requirements specified in this handbook to complete their program.

Home Unit Teaching Apprenticeship and Extra-curricular Requirements

Robotics Ph.D. students are subject to their home unit's teaching apprenticeship requirements (e.g., a certain number of semesters serving as a TA) and other extra-curricular requirements such as seminar attendance or annual review process. For example, students with home units in IC are required to do two semesters of teaching practicum or apprenticeship and register for the corresponding courses. Students should contact their home units for details for any departmental requirements that are in addition to the Robotics degree requirements. Students are responsible for ensuring that they understand and satisfy any home unit requirements as well as the Robotics program and Institute requirements.

See appendix for more details on home units.

Course requirements

Program of Study

The Ph.D. curriculum makes extensive use of existing courses in the College of Computing and the College of Engineering. Three additional courses provide a one-semester introduction to robotics topics and a two-semester multidisciplinary robotics research experience. Students are required to complete 33 semester hours of coursework in core robotics areas: Mechanics, Controls, Perception, Human-Robot Interaction (HRI), and Artificial Intelligence (AI).

The main emphasis of the Ph.D. program is the successful completion of an original and independent research thesis. The degree requirements are designed around this goal.

Minimum Requirements

- Completion of 33 semester hours of courses with a letter grade
- Passing a comprehensive qualifying exam with written and oral components.
- Successfully conducting, documenting, and defending a piece of original research culminating in a doctoral thesis.

More information about the Institute-level requirements for the PhD degree can be found here: http://www.catalog.gatech.edu/academics/graduate/doctoral-degree-info/

Ph.D. Robotics Degree Requirements – 33 semester hours with a letter grade

Component	Courses	Hours Required
Intro to Robotics Research	CS/AE/ECE/ME 7785, Introduction to Robotics Research.	**3**
Foundation Courses	Three foundation courses, each selected from distinct core areas: Mechanics, Controls, Perception, Artificial Intelligence, and Human-Robot Interaction (HRI).	**9**
Elective Courses	Three targeted elective courses, each selected from the same three core areas used for the foundation courses.	**9**

Multidisciplinary Robotics Research	Two courses CS/AE/ECE/ME 8750 and CS/AE/ECE/ME 8751, Multidisciplinary Robotics Research I and II.	**6**
Courses Outside the Major (Doctoral Minor Field of Study)	Two courses outside the major area to provide a coherent minor in accordance with Institute policies.	**6***
	TOTAL	**33**

A list of previously approved courses and the relevant categories for the coursework requirements is listed in the Appendix. Any course not listed will require approval - No exceptions. The ROBO Program Director reviews and approves requests from students to count courses currently not listed as approved.

*A maximum of two classes (6 semester hours) at the 4000 level may be used to satisfy the minor requirements only. No courses used to satisfy any bachelor's degree requirements can be used towards a graduate degree.

The coursework requirements are subject to change. Students can satisfy any version of them that are in effect from the date of matriculation into the program and through the entirety of the program.

Responsible Conduct for Research (RCR)

All doctoral students at Georgia Tech are required to complete a two-step RCR training process.

- The first step is an online training course that must be completed within 90 days of a student starting the Ph.D. program.
- The second step is an in-person training course. There is a general PHIL 6000 as well as courses offered by specific academic units. Check with the home school to see if the PHIL 6000 or a specific RCR course is required. This 2-credit hour course is taken on a pass/fail basis, and all students must pass the course to receive the RCR credit. Students are not able to be admitted to candidacy without completing the RCR courses.

Minor Field of Study

The Robotics Ph.D. Minor consists of two related courses (six semester credit hours) *outside of robotics* that forms a coherent field of study in accordance with the Institute's policies. The minor courses must be distinct from any of the robotics core areas (i.e., are not listed under any of the 5 core areas on this website or a Robotics course) but can be taken from the student's home school as long as they are distinct from robotics courses (e.g., ECE-ROBO student can take ECE circuits courses or ME students can take fluid mechanics courses).

• To officially declare the doctoral minor with the Institute, there is a required form, The Doctoral Minor form, which is available through the GT Office of Graduate Studies via docusign: https://grad.gatech.edu/theses-dissertations-forms

This form must be signed by the student's faculty advisor (major advisor) and the Robotics Graduate Coordinator. Generally, this form is submitted at the time of the thesis proposal, but must be completed before graduation.

• Students must also submit an internal form, the ROBOTICS PH.D. PROGRAM MINOR JUSTIFICATION, to the Robotics Program Director with an updated Program of Study form:

PhD ROBO Minor Justification

Program of Study Coursework Plan

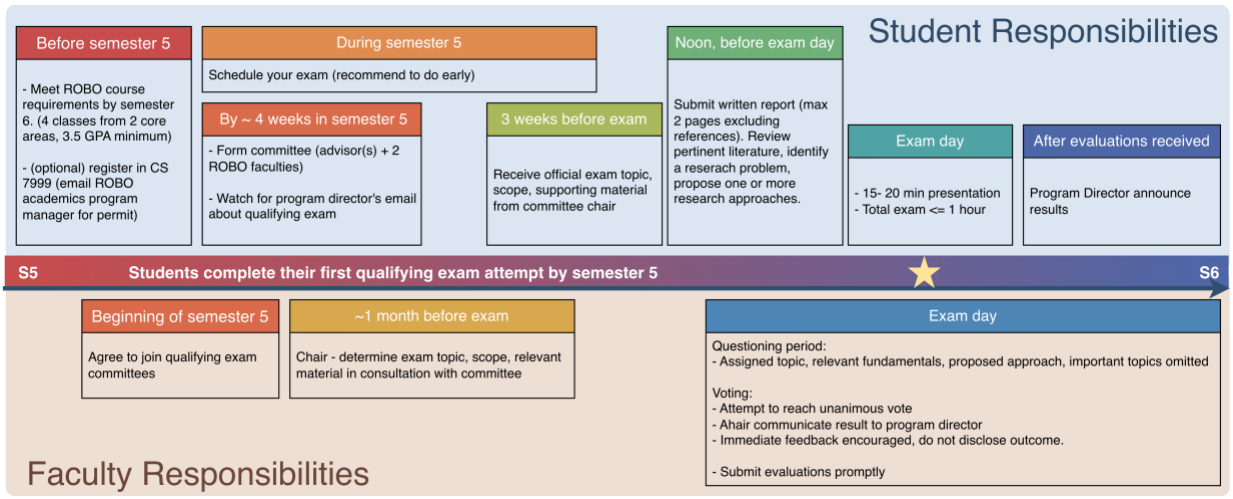
Students must submit a coursework plan via a Program of Study, (see links to access the forms below), to the Program Director via a Canvas site for the Robotics program, throughout their program including:

- End of the first semester
- Before Quals
- Before Thesis Proposal
- Anytime there is a significant change to coursework

Note students will be sent an invitation to the Robotics Canvas site during the fall semester after which time they may upload their PoS, (also available for download on the canvas site)

- Students who entered the PhD in Robotics program **before** Summer 2024: Program of Study (POS)
- Students who entered the PhD in Robotics program in Summer 2024 or later: Program of Study (POS)

Qualifying Exam



The purpose of the qualifying exam is to:

- Assess the student's general knowledge of the degree area
- Assess the student's specialized knowledge of the chosen research area

The qualifying examination provides an early assessment of the student's potential to satisfactorily complete the requirements for the doctoral degree. As such, it requires that fundamental principles be mastered and integrated so that they can be applied to solving problems relevant to robotics.

The Robotics Ph.D. qualifying exam has two components, and the student is required to pass both to continue in the program:

1. Course-based GPA requirement
2. Comprehensive oral examination

Course-Based GPA Requirement

To pass the course-based GPA requirement, the student must maintain a GPA of 3.5 or higher in 4 courses taken at Georgia Tech from exactly 2 distinct core areas from the 5 core areas of robotics curriculum. Two of these courses must be foundation courses (1 course from each core area, say core area, C1 and core area, C2). The remaining two courses may be either elective or foundation with one course from the first core area, C1, and the second course from the second core area, C2. Two Foundation courses from the same core area are accepted only if credit is allowed for both courses simultaneously (i.e., only if they cover different subject areas). The student must complete the four courses for the GPA requirement by the end of the 6th semester (which includes summer semesters) of starting in the program.

Comprehensive Oral Examination

Goals of the oral exam include the following:

- Determine student's ability to understand and apply fundamental concepts in the general area of Robotics
- Determine the student's ability to conduct independent research and review, synthesize, and evaluate previous work from the literature
- Identify areas of weakness that the student may need to improve upon

Procedure

At the beginning of each fall semester, the Program Director will send an email to all ROBO PhD students and ROBO faculty with information regarding the qual exam and how to initiate the process for the upcoming academic year (fall and spring semesters).

Students planning to take the Doctoral Qualifying Examination may (but do not have to) enroll in CS 7999: Prep for Doctoral Qualifying Exam (Section ROB) with the Program Director during the fall or spring semester in which they intend to take the exam. Students should email the Robotics Academic Program Manager and provide their GTID to request a permit during Phase I or Phase II registration. Enrollment in CS 7999 is **not** required to take the Qualifying Examination; however, students may choose to enroll if they need additional credit hours to maintain full-time enrollment. Students who elect to take CS 7999 will register for the course regardless of their home unit.

Committee Composition

The oral exam committee consists of the student's advisor(s) and two additional Robotics faculty members assembled in consultation with the student and their advisor. If a student has more than one advisor, the student's co-advisors may also be members of the committee, but only one advisor

may cast a vote on behalf of all advisors (see below). Students will be prompted to form their qualifying exam committees for the upcoming academic year (fall or spring) in early September.

The committee chair must be one of the non-advisor members and will be appointed by the Robotics Program Faculty Committee.

Exam Scheduling

The first attempt for the comprehensive oral exam must be made before the end of the 5th semester after entering the program (including summer semesters). The student must pass the exam, including any re-takes, by the end of the 8th semester (which includes summer semesters) of starting in the Ph.D. program.

The first oral examinations will only be given in the fall and spring semesters. The oral exam retakes may be scheduled during the summer semester upon availability of the exam committee members.

Topic Assignment

Three weeks prior to the scheduled oral exam date, the committee, in consultation with the student, will assign the student's oral exam topic and scope. The topic should be one that is relevant to the student's future doctoral work and may be based on the student's work in the Multidisciplinary Robotics Research (8750/51) courses, M.S. dissertation, or an influential research article(s). The chair of the exam committee will communicate the exam topic and supporting materials to the student and other committee members. The student is expected to investigate the assigned topic and produce a written report and oral presentation.

Written Report

The student must submit to the exam committee a written summary report by noon on the day before the oral exam. The report is up to two pages excluding references and must: 1) review the pertinent literature, 2) identify a research problem in that topic area, and 3) propose a possible solution approach/approaches to the identified problem related to the topic that the student deems worthy of research.

Exam Day Presentation and Discussion

The oral exam begins with a 15–20-minute presentation by the student based on the oral exam topic, leading to further questions related to the goals of the oral exam. In addition to exploring the original topic, the exam committee members may ask questions on fundamentals relevant to the original topic, areas that the student identified as part of their research approach to the topic, or obvious omissions by the student, i.e., things the student should have considered but missed in the written response, initial presentation, or subsequent discussion that followed. The total length of the oral exam is limited to one hour.

Deliberation and Voting

In the event the committee exceeds three members due to additional co-advisors on the committee, only one advisor may cast a vote. The voting committee therefore consists of exactly three members: one advisor vote and two non-advisor faculty votes. The chair will identify the three voting members of the committee prior to the start of the exam.

After the exam, any co-advisors may deliberate among themselves, after which only the voting members of the committee will deliberate with the goal of reaching a unanimous decision. Passing the exam requires a unanimous vote by the committee and every effort should be made by the committee to reach consensus. If the committee cannot reach a clear pass/fail decision, the committee chair will refer the case to the Program Director, who will bring the case to the Robotics Program Faculty Committee for a decision. The Robotics Program Faculty Committee may, at the conclusion of its deliberation, decide pass, fail, or require the student to retake the exam.

After the exam, the voting committee members will convey their vote and any comments and feedback for the student via the form distributed by the Robotics Program Faculty Committee at the time of exam committee assignment. The Program Director will subsequently convey the results to the student.

The exam committee members are encouraged to communicate timely feedback to the student without informing them of the exam outcome.

The student is encouraged to confirm that all exam committee members submit their vote and exam outcome in a timely manner.

Exam Retake

If the student fails the oral exam on the first attempt, they are allowed one retake of the oral exam, which should occur in the semester following the first attempt, including summer semesters. The retake may occur in a later semester, subject to approval by the exam committee. Any retake should be completed with the same committee; any changes to the committee are subject to approval by the Robotics Program Faculty Committee and require justification. The retake topic and scope will be assigned by the retake committee in consultation with the student. The exam must be completed by the end of the 8th semester, including summer semesters, after starting the Ph.D. program.

Qualifying Exam Appeals Process

If a student fails the oral exam on their second attempt, they have the right to appeal the decision to the Program Director, who will refer the matter to the Robotics Program Faculty Committee to confirm or reverse the outcome of the qualifying exam process. The Robotics Program Faculty Committee will hear only from the student's voting advisor and the exam committee chair before deciding whether the student may remain in the program.

Ph.D. Candidacy

Admission to PhD Candidacy requires that the student:

- Complete the requirements for training in Responsible Conduct for Research (RCR);
- Complete all course requirements (except the minor);
- Achieve a satisfactory scholastic record;
- Pass the comprehensive examination;
- Submit a formal institute document naming the dissertation reading committee and delineating the research topic for approval to the school chair and Graduate Students (on behalf of the Vice Provost for Graduate Education and Faculty Affairs).

PhD Thesis Proposal Process

Thesis Proposal Guidelines

The final requirement to admission to candidacy is the PhD proposal, which consists of a short document describing the student's thesis, and a presentation to a proposal committee.

The Ph.D. thesis proposal describes the results of a research project and demonstrates that the candidate possesses powers of original thought, talent for research, and ability to organize and present findings.

Advisory Committee

The student presents and defends a written Ph.D. proposal to a Dissertation Advisory Committee of at least five faculty members approved by the Robotics Program Committee. The Dissertation Advisory Committee consists of five or more members where:

- At least three members must be faculty affiliated with the Robotics Program or from the student's Home School (IC, AE, BME, ECE, ME).
- At least two members must be from outside of the student's Home School

Ph.D. Proposal

The objective of the Ph.D. Proposal is to allow an early assessment of a student's chosen topic of research for the satisfactory completion of the doctoral degree. The proposal should delineate the student's specific area of research by stating the purpose, scope, methodology, overall organization, and limitations of the proposed study area. The proposal must include a review of the relevant literature and indicate the expected contribution of the research.

The proposal should be organized as follows:

- Summary - limited to 200 words.
- Table of Contents
- Project Description - a clear statement of the work to be undertaken. Limited to 15 pages single-spaced (30 pages double spaced) and including all graphic elements and tables.
- Bibliography

Pages should be of standard size (8½" x 11"; 21.6 cm x 27.9 cm) with minimum 1" or 2.5 cm margins at the top, bottom, and on each side. The minimum type font size is 10 to 12 points.

Submit the following documents to the Chair, Robotics Ph.D. Program:

a) One copy of the dissertation proposal as detailed above;
b) An up-to-date Program of Study showing all classes taken so far;
c) Ph.D. Proposal Review Request form – signed by both student and advisor

After the thesis proposal presentation with their committee, students must submit the Graduate Studies *"Request for Admission to Ph.D. Candidacy"* to formally become a PhD candidate at Georgia Tech. See details below under "Institute Thesis forms."

Note there must be a **minimum of six months** between approval of the proposal and scheduling of the dissertation defense.

In addition to the above requirements, students should also follow the policies and procedures for the thesis of their home school, as some may have additional requirements, (e.g, CoC requires a gap semester between the thesis proposal and defense).

Dissertation Defense

The dissertation, when completed, must be publicly defended before an Examination Committee approved by the Graduate Education office. In most instances, the Examination Committee is expected to be the same as the Dissertation Advisory Committee. If a candidate should fail to pass the final oral examination, the Examining Committee may recommend permission for one additional examination. It is expected that the dissertation results will be published in peer-reviewed journals and conferences.

The "*Certificate of Thesis Approval*" form and additional paperwork is required after the defense. See details below under "Institute Thesis forms" and for preparing and submitting a dissertation and all associated requirements and deadlines according to institute guidelines at: https://grad.gatech.edu/theses-dissertations

Additional requirements for Thesis Proposal and Defense

Announcements

Students are responsible for announcing their thesis proposal and defense presentations 10-14 days before the event. Please send emails to the following listservs and "CC" the thesis committee members:

- Home unit listserv
- phd-robo-official@cc.gatech.edu
- announcements@grad.gatech.edu
- phdprogram@robotics.gatech.edu

Institute Thesis Forms

After the thesis proposal and defense presentations, students are responsible for initiating the DocuSign process for the appropriate Institute forms.

- After the thesis proposal, student must submit the *"Request for Admission to Ph.D. Candidacy"* to formally become a PhD candidate at the Georgia Tech.

- The "*Certificate of Thesis Approval*" form is required after the defense.

Both forms can be found here, under the `Doctoral Students' header.

AE, BMED, ECE, IC ROBO students ONLY: In each form, the Grad Coordinator should be the name and email of the ROBO Program Director or the ROBO Academic Program Manager, while students should list the School Chair of their home school and all committee members. Note under "School," please list as "ECE - Robotics, AE – Robotics, etc." so both major and home school are recorded.

ME-ROBO students ONLY: In each form, the Robotics Program Director will sign your forms as the Grad Coordinator AND “School Chair”.

Online Application for Graduation OAG

Students should refer to the Registrar’s Online Application for Graduation (OAG) and submit a petition to graduate the semester before they plan to graduate. (e.g., if planning to graduate in Spring 2026, then the OAG is due in Fall 2025). This allows time to correct any unfulfilled requirements identified by the Office of Graduate Studies. See the GT academic calendar for OAG deadlines: https://registrar.gatech.edu/calendar. If a student has previously applied but did not graduate, they must repeat the same process to graduate.

To view graduation status, login to DegreeWorks. Near the top of the audit, under a section titled *Student View*, there will be a field for *Graduation Information*. The text that appears in that field is the current graduation application status. To review missing requirements, see the section *Degree Requirements*.

NOTE: The status “lacks thesis” may appear on OSCAR for several weeks after the thesis or dissertation has been accepted by the Graduate Thesis Office as both the Graduate Thesis Office and the Registrar must do some processing of records. Acceptance by the Graduate Thesis Office, documented either by an approval e-mail for the ETD or a copy of the signed Certificate of Thesis Approval, is assurance that everything is okay.

Degree completion and verification letters: https://registrar.gatech.edu/info/forms-list-certifications-and-verifications

The GT Registrar has various forms to request letters, depending on a student’s current status and needs, such as: Degree Completion Verification • Enrollment Certification • Letters of Completion • Verification of a Pending Degree

Please contact the Registrar with any questions: comments@registrar.gatech.edu

Graduation and Commencement Information

For all things related to graduation and commencement, including dates, RSVP, regalia purchase info, and day of event info: https://commencement.gatech.edu/

Questions: events@comm.gatech.edu

Last semester Registration Options

Students that are completing their Ph.D. may find that the timing of their defense, graduation, and start of their subsequent employment leads to an ambiguity in how they should register for their final semester at Georgia Tech. There are, in general, three options (see Pages 5-6 of the Thesis Manual for more details and rules).

- OPTION 1: Register as normal (i.e., xx9000 doctoral thesis hours). This works fine if the final version of the thesis is submitted in time for graduation in the last semester (see the deadlines), and there are no funding limitations.
- OPTION 2: The 1-credit hour option. Students in their graduating semester can register for only 1 hour of xx9000. Such students are, of course, not full-time and will therefore not receive a tuition waiver or be able to be paid as a GTA or GRA. These students must therefore pay the 1-hr of tuition and fees (~$780/in-state and ~$1400/out-of-state). Students may be hired as a Graduate Assistant (GA) by their advisor and paid hourly, depending on advisors and their department. [NOTE: Students who are US citizens are ineligible for student health insurance if they are registered for less than 4 credit hours. Such students should contact STAMPS Health Services and consider their options before registering for 1-credit hour.] Students can use the 1-credit hour option only once while at Georgia Tech.
- OPTION 3: Enrollment Waiver. This is for students who missed the final submission deadline for their target graduating semester, but have successfully defended, submitted their thesis, and are ready to start their job. They therefore have to stay 'on the books' at Georgia Tech to graduate the following semester, even though they may not ever be on campus during the semester. The Enrollment Waiver allows a student to stay 'on the books' and not register for any hours or pay any money. To use the Enrollment Waiver, complete the form via Grad Studies DocuSign. Note that all thesis-related forms must be completed and submitted for the Enrollment Waiver to be approved.

Note: International students should contact OIE via istart if registering for less than full-time to request an academic reduced course load.

If none of these seem to fit, students should discuss their case with the Registrar's Office.

Administrative Matters

Financial Support

All issues of financial support are a matter between the home school, hiring unit (if position is outside of home school), faculty advisor, and the student. The student's home school is responsible for the administration of tuition waivers.

Please follow the home school's policies regarding forms and deadlines to avoid any discontinuation of support. This is especially important if the student's home school is not that of the faculty advisor.

Two main types of financial aid are available to qualified graduate students:

1.GRA/GTAs (Graduate Research Assistantships/Graduate Teaching Assistantships). These are awarded on the basis of academic potential and performance and not on the basis of need. They are awarded either at the time of offer of admission or by a faculty member wishing to support the student in their laboratory as a GRA. Please note: If a student is admitted without financial support, it is a student's responsibility to secure any funding. The last day a student can be placed on a GRA for the semester is the last day of the first week of classes. After this date, even if a professor wishes to financially support a student, the student cannot be supported as a GRA until the following semester.

2. External Fellowships. Students are highly encouraged to apply for external fellowships. Most are only available to US citizens and permanent residents. For more information, see https://grad.gatech.edu/paying-for-grad-school.

Note both of these types of financial support require students to be enrolled for full-time.

GT Graduate Student Enrollment and Employment:
https://policylibrary.gatech.edu/academic-affairs/graduate-student-enrollment-and-employment

For **current GT tuition and fees**, please see the Bursar's Office at:
https://bursar.gatech.edu/Tuition-Fees

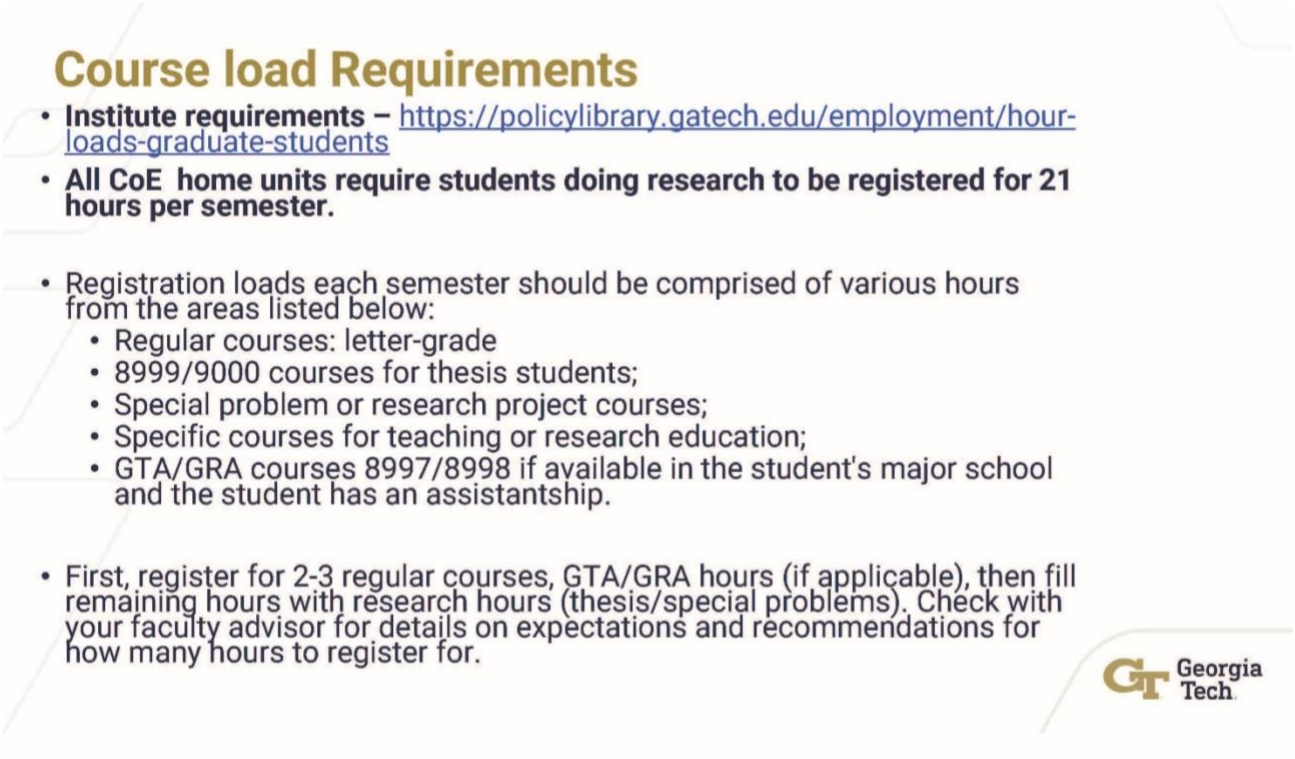
Registration

All previously enrolled graduate students are required to register for Georgia Tech coursework during Phase I registration for the following semester. Phase I registration occurs midway through the current semester.

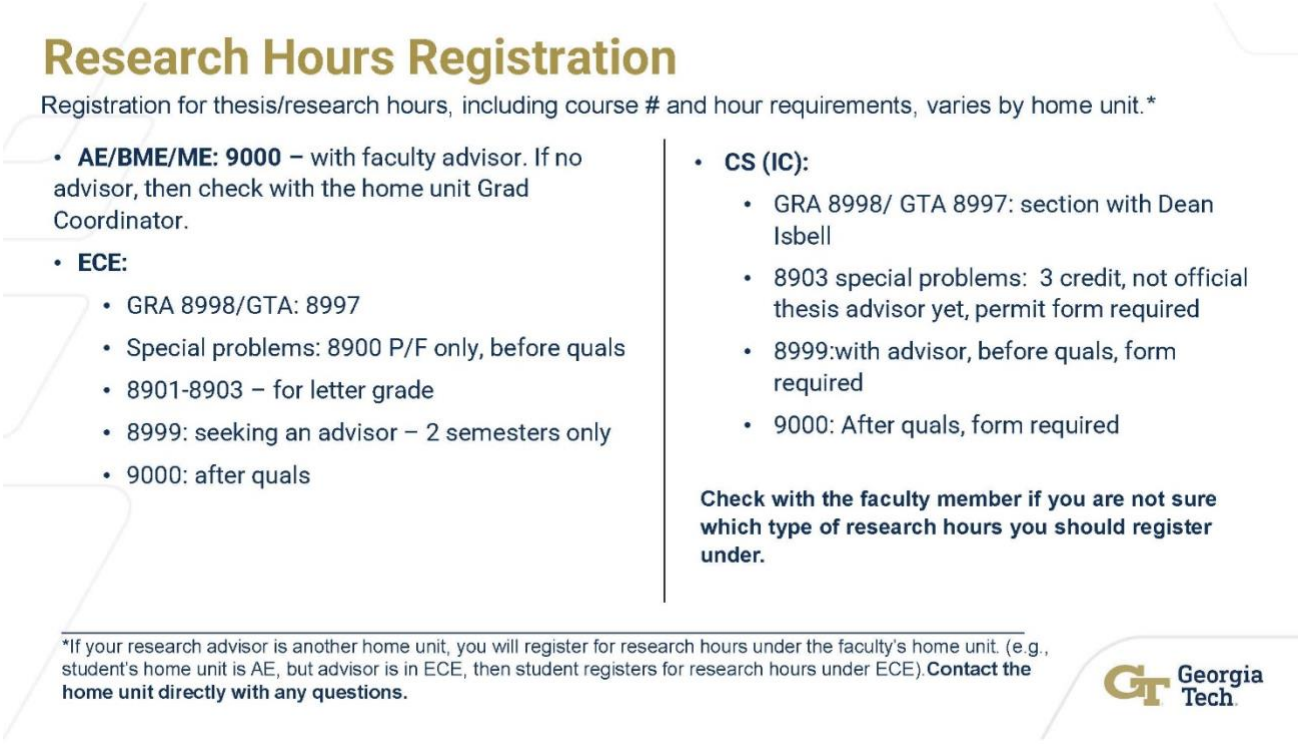
New graduate students will register during Phase II for their first semester. After the first semester, new graduate students will be able to register during Phase I. Information regarding registration can be found online at https://oscar.gatech.edu/.

The ROBO Academic Program Manager will send registration reminders and information prior to start of phase I and II registration periods. Please be sure to read these emails and save for reference.

Students must register for a minimum of 12 hours (9 hours must be letter grade or pass/fail and only 3 hours may be audit hours) to be full-time, which is required for international students and students with a GRA/GTA. Some home schools may have additional requirements for registering for research hours; for example, most home schools in the College of Engineering (e.g., AE, ECE, etc.) require students to be registered for 21 hours in the fall and spring semesters and 16 hours in the summer semester.



After registering for coursework, remaining hours should be registered for thesis/research hours under the same unit as the student's faculty research advisor, even if it is not the same as the student's home unit. For example, if a student is in AE, but their advisor is in ECE, then they will register for thesis hours in ECE. Some schools may have other required hours to register for GRA/GTA (e.g., 8998 and 8997), so be sure to check with that unit for details.



In rare cases, a student may be enrolled part-time; however, do not enroll part-time unless the student has consulted with the program, home school, and faculty research advisor. It could jeopardize funding and/or cause additional tuition and fees out of pocket. Please be aware of registration deadlines for the upcoming semester, especially when students are only doing research and still must register for research hours. Registration dates are available online at http://www.registrar.gatech.edu/.

There is no reprieve for forgetting to register – the student will not be eligible to be paid as a GRA and will be responsible for paying all tuition and fees for the following semester. The GT Registrar is strict with respect to fee payment and registration deadlines, so make sure to register on time!

Registration policies and procedures vary by home unit. Note permits can only be issued by the home unit offering the course. **ROBO staff cannot issue permits for courses.**

Contact the unit offering the course for any questions about how to register for courses. https://registrar.gatech.edu/registration/permits-and-overloads

How to Register and all things registration related, including error messages, holds, how to videos, permit info: https://registrar.gatech.edu/registration

It is a student's responsibility to ensure degree requirements and full-time status requirements are met.

Pre-Requites

For most graduate level classes such as CS courses are informational only and will not prevent registration. Check with the academic department offering the course if the student gets a pre-req registration error or contact the course instructor with any questions.

Special Course Types

Special Topics (xx8803, 8813, 8843, etc) – These courses are offered on a limited basis and NOT permanently listed in the GT Catalog. Any Special Topics course taught by a faculty member in any of the ROBO home units may be used as a core elective with prior approval. Check with the ROBO Program Manager if any questions or if not sure which core area the course may counts towards.

List of approval Special Topics courses may be found at: **Robotics courses - all.docx**

Special Problems (xx89x3, etc) – These are research projects with a Robotics faculty member in *any* home unit and will require faculty approval and a permit to register from the faculty's home department. See academic unit for more details. **Special Problems must not be also paid as GRA for the same work on a project in the same semester.** It is a student's responsibility to seek out these opportunities if desired and register correctly per the home unit.

Transfer credit and Course Waivers

There is no formal transfer of credit for the Ph.D. degree where classes taken at another institute would appear on the Georgia Tech transcript. However, graduate coursework completed at other schools may be used toward the Ph.D. coursework requirement.

Students may waive up to 6 courses (18 hours) from other schools. Courses must be graduate level and not used to satisfy any undergraduate degree requirements.

Note CS/AE/ECE/ME/BME 7785, CS/AE/ECE/ME 8750, and CS/AE/ECE/ME 8751 cannot be waived.

How to Submit a Course Waiver Request

To request course waivers, students should send an email to the ROBO Academic Program Manager with the transcripts and syllabi from the other school, along with using the following format below:

Previous Univ. Course	Letter Grade Earned	GT Course	Category (Foundation or Elective)	Most Recent GT Faculty Instructor of GT Course (This info can be found in OSCAR
CS 15673	A	CS 6476	Foundation	James Hays

As noted in the format above, please include the name of the course(s) from your previous institution, the Georgia Tech course you believe it is most equivalent to, the letter grade earned, the most recent GT faculty instructor for the equivalent course, and whether the course fulfills a foundation or elective requirement. Including links to course descriptions or syllabi from both the previous institution and Georgia Tech is strongly encouraged.

The ROBO Academic Program Manager will coordinate with faculty in the relevant departments to evaluate waiver requests. Please note that this process may take several weeks or months, depending on faculty availability and response times.

Course waiver evaluations may only be requested after a student has matriculated into the program and after the second week of classes. Requests will not be reviewed during Phase II registration of any semester (August or January).

Note it is not guaranteed that decisions will be received in time for registration since it is dependent on the faculty's review and response timing. Therefore, it is recommended to plan ahead and submit your requests as early as possible.

MS on the way

Ph.D. students can obtain an MS degree “on the way.” Generally, the MS degree is completed through a student’s home unit, so please check with the home unit for specific requirements.

After approval from the academic unit offering the MS degree, complete the Graduate Change of Major form. Fill out the top part of the form, select 'Add A Master's Degree Level' and submit the form to the ROBO Academic Program Manager and then to the academic department of the MS degree. When completing the Change of Major form, please be sure to CC the ROBO Program Manager, Chris Middleton. Submit this form to the registrar **before** Phase I registration of the semester preceding the semester in which a student expects the degree. This allows time to correct any unfulfilled requirements identified by the academic unit or the Registrar.

During the semester preceding the semester when the MS degree is expected, a student must submit an Online Application for Graduation.

For info on how to add the MSCS, please see the ROBO Academic Program Manager for details on the process. Note inquiries regarding the MSCS program and requirements should be sent directly to the MSCS advisor (not the ROBO advisor). If the student is from outside of the CoC, a minimum of 3 CS courses with letter grades must be completed before consideration and will need to be reviewed by CoC upper administration for approval.

For other master’s degrees (MSME, MSECE, etc.), please contact the academic department for further details on their options, degree requirements, and application process.

PhD degree and MS ROBO

Since the MS ROBO program is a terminal degree, it cannot be pursued “on the way” for PhD students. In special circumstances, a PhD student may desire to switch from the PhD in Robotics to the MS in Robotics and should contact the ROBO Academic Program Manager to discuss this process.

Graduate Internship Program - GT Career Center

The Graduate Internship program through the Georgia Tech Career Center provides graduate students with the opportunity to work with industry and government leaders in their respective areas of study. Eligibility for the program is based on academic achievement at Georgia Tech. Research for master's and doctoral theses may be related to the work assignments and is jointly supervised by Georgia Tech faculty and company staff. There is no tuition associated with the Graduate Internship Program, nor are there any required fees. Students are provided full-time enrollment status through registration in an audit credit Graduate Internship course. This permits students to retain all privileges of full-time enrolled students while on work assignments.
https://career.gatech.edu/graduate-internship-program-information

Program requirements, deadlines, and application info: https://career.gatech.edu/graduate-student/application-process.

Note the advisor approval form must be signed by the faculty advisor as well as the ROBO Academic Program Manager. To avoid delays, please send the following information in a separate email to the ROBO Manager before submitting the Career Center docusign request: 1). please confirm if the student will have a GTA or GRA for the semester 2). please confirm the expected graduation date (semester and year).

For domestic students with an external internship, it is recommended, but not required to participate in the Graduate Internship program.
International students with external internships are required to participate in the Graduate Internship Program and use the CPT work authorization. Students must be in F-1 status for at least two semesters before they are eligible to work off-campus. For more info on CPT, please see OIE’s info at: https://isss.oie.gatech.edu/content/curricular-practical-training-cpt-georgia-tech

Appendix

Administration and Governance

Program Director
Dr. Sam Coogan

MS and PhD ROBO Academic Program Manager
Christian Middleton

Additional Information, forms, and Links

RoboGrads student organization**:** http://robograds.gatech.edu/

*Sign up for their mailing list at above link!

Institute for Robotics and Intelligent Machines (IRIM): https://robotics.gatech.edu/

Program of study form: PhD_ROB_ProgStudy-2.pdf

General Catalog: http://www.catalog.gatech.edu/rules/

Catalog Information for Grad Students: http://www.catalog.gatech.edu/academics/graduate/

Graduate Institute Policies:https://catalog.gatech.edu/academics/graduate/doctoral-degree-info/#header

https://catalog.gatech.edu/academics/graduate/work-loads/

https://policylibrary.gatech.edu/academic-affairs/graduate-student-policies

GT Policy Library: https://policylibrary.gatech.edu/

Registrar's Office: http://www.registrar.gatech.edu • Registration, Graduation, Commencement, Degree Completion Verification • Enrollment Certification • Letters of Completion • Institute Academic Policy

Office of International Education: https://www.oie.gatech.edu/ • Visa and Immigration Matters • Optional Practical and/or Curricular Practical Training Matters

Bursar's Office: http://www.bursar.gatech.edu • Student financial accounts, Fee Payments • Refunds

Career Center: career.gatech.edu• Internship Opportunities • Graduate Internship Program • Career Fairs and other professional development events and workshops

GT Graduate Studies Office: http://www.grad.gatech.edu • Thesis Deadlines, Thesis Submission Procedures and Forms

Student Financial Assistance: http://www.finaid.gatech.edu • Loans • Tuition Waivers • Fellowships

Robotics PhD Program Home Units

****Note this guide is to be used for general purposes only and is not comprehensive and therefore should <u>not</u> be used in place of direct advisement from the home unit****

For full and up-to-date details, please contact the home unit directly to confirm any requirements and request advising regarding their departmental requirements as they may have specific conditions and are subject to change.

- **Aerospace Engineering (AE)**
  - AE Graduate Coordinator: Dr. John Christian
  - Contact: Ryan Sanders: rsanders72@gatech.edu
  - AE Handbook: https://ae.gatech.edu/ae-graduate-handbook

- **Biomedical Engineering (BME)**
  - GTA and seminar requirements: Interdisciplinary students are exempt
  - BME Graduate Coordinator: Dr. Michael Davis
  - Point of Contact: Mitchell Everett, Academic Program Manager: mitchell.everett@bme.gatech.edu

- **Interactive Computing (IC)**
  - GTA requirements: https://www.ic.gatech.edu/content/policies-regarding-gtas-and-tas
  - Annual Ph.D review: http://www.ic.gatech.edu/current/phdreview
  - IC Graduate Coordinator: Dr. Thomas Ploetz
  - Point of Contact: Theresa Nash, Academic Program Manager, tnash33@gatech.edu.

- **Electrical and Computer Engineering (ECE)**
  - ECE Graduate Coordinator: Dr. Mark Davenport
  - Point of Contacts:
    - Daniela Staiculescu, Senior Academic Professional: daniela@ece.gatech.edu
    - Tasha Torrence, Academic Advising Manager: tasha.torrence@ece.gatech.edu
  - ECE Handbook 2024-2025: https://www.ece.gatech.edu/sites/default/files/documents/graduate/current_grad_handbook.pdf

- **Mechanical Engineering (ME)**
  - Teaching Practicum requirement: https://www.me.gatech.edu/teaching-practicum-0
  - Seminar requirement: https://www.me.gatech.edu/seminars-4
  - ME Graduate Coordinator: Dr. Andrei Fedorov
  - Point of Contacts:
    - Glenda Johnson, Academic Advising Manager: glenda.johnson@me.gatech.edu (Last Names M-Z)
    - Camellia Henry, Academic Advisor: camellia.henry@me.gatech.edu (Last Names A-L)

Course listings

Core Area Courses**

The following courses are in the robotics core areas of Mechanics, Control, Perception, Artificial Intelligence, and Human-Robot Interaction (HRI). They are used to select three foundation courses and three targeted elective courses.

Foundation courses are in **bold** and marked by an asterisk (*).

Component	Courses
Mechanics	Students may take two foundation courses – one in Robotics (BME 8813 or ME 6407) and one in Dynamics (AE 6210 or ME 6441) and use the second foundation class in place of a mechanics elective course. • **AE 6210*, Advanced Dynamics I – Kinematics of particles and rigid bodies, angular velocity, inertia properties, holonomic and nonholonomic constraints, generalized forces. Prerequisite: AE 2220. 3 credit hours** • AE 6211, Advanced Dynamics II – A continuation of AE 6210. Equations of motion, Newtonian frames, consistent linearization, energy and momentum integrals, collisions, mathematical representation of finite rotation. Prerequisite: AE 6210. 3 credit hours • AE 6230, Structural Dynamics – Dynamic response of single-degree-of-freedom systems, Lagrange's equations; modal decoupling; vibration of Euler-Bernoulli and Timoshenko beams, membranes and plates. Prerequisites: AE 3120, AE 3515. 3 credit hours • AE 6263, Flexible Multi-Body Dynamics – Nonlinear, flexible multi-body dynamic systems, parameterization of finite rotations, strategies for enforcement of holonomic and non holonomic constraints, formulation of geometrically nonlinear structural elements, time-integration techniques. Prerequisites: AE 6211, AE 6230. 3 credit hours • AE 6270, Nonlinear Dynamics – Nonlinear vibration methods through averaging and multiple scales, bifurcation, periodic and quasi-periodic systems, transition to chaos, characterization of chaotic vibrations, thermodynamics of chaos, chaos control. Prerequisite: AE 6230. 3 credit hours • AE 6520, Advanced Flight Dynamics — Reference frames and transformations, general equations of unsteady motion, application to fixed-wing, rotary-wing and space vehicles, stability characteristics, flight in turbulent atmosphere. 3 credit hours • **BMED 8813*, Robotics — Robot kinematics, statics, and dynamics. Open-chain manipulators and parallel manipulators as well as an understanding of trajectory planning and non-holonomic systems. 3 credit hours** • CS 7496, Computer Animation — Motion techniques for computer animation and interactive games (keyframing, procedural methods, motion capture, and simulation) and principles for storytelling, composition, lighting, and interactivity. 3 credit hours • AE/ME 6705, Introduction to Mechatronics – Modeling and control of actuators and electro-mechanical systems. Performance and application of microprocessors and analog electronics to modern mechatronic systems. Prerequisites ME 3015 or equivalent, or with the consent of the instructor. 4 credit hours • **ME 6407*, Robotics – Analysis and design of robotic systems including arms and vehicles. Kinematics and dynamics. Algorithms for describing, planning, commanding and controlling motion force. Prerequisites ME 3015 or ECE 3085. 3 credit hours** • **ME 6441*, Dynamics of Mechanical Systems – Motion analysis and dynamics modeling of systems of particles and rigid bodies in three-dimensional motion. Prerequisites: ME 3015 or equivalent, or with the consent of the instructor. 3 credit hours** • ME 6442, Vibration of Mechanical Systems – Introduction to modeling and oscillatory response analysis for discrete and continuous mechanical and structural systems. Prerequisites: ME 3015 and ME 3201. 3 credit hours • ME 7442, Vibration of Continuous Systems – Equations of motion and oscillatory response of dynamic systems modeled as continuous media. Prerequisites: ME 6442 or equivalent, or with the consent of the instructor. 3 credit hours
Control	• AE 6252, Smart Structure Control – Modeling smart sensors and actuators, development of closed loop models, design of controllers, validation of controllers, application to vibration control, noise control, and shape control. Prerequisite: AE 6230. 3 credit hours

- AE 6504, Modern Methods of Flight Control – Linear quadratic regulator design. Model following control. Stochastic control. Fixed structure controller design. Applications to aircraft flight control. Prerequisite: AE 3521. 3 credit hours
- AE 6505, Kalman Filtering – Probability and random variables and processes; correlation; shaping filters; simulation of sensor errors; Wiener filter; random vectors; covariance propagation; recursive least-squares; Kalman filter; extensions. Prerequisite: AE 3515. 3 credit hours
- AE 6506, Guidance and Navigation – Earth's shape and gravity. Introduction to inertial navigation. GPS aiding. Error analysis. Guidance systems. Analysis of the guidance loop. Estimation of guidance variables. Adjoint analysis. Prerequisite: AE 3521. 3 credit hours
- AE 6511, Optimal Guidance and Control – Euler-Lagrange formulation; Hamilton-Jacobi approach; Pontryagin's minimum principle; Systems with quadratic performance index; Second variation and neighboring extremals; Singular solutions; numerical solution techniques. Prerequisite: AE 3515. 3 credit hours
- **AE 6530*, Techniques for analysis and description of multivariable linear systems. Tools for advanced feedback control design for these systems, including computational packages. Credit will not be awarded for both AE 6530 and ECE 6550 or AE 6530 and ME 6401. 3 credit hours.**
- AE 6531, Robust Control I – Robustness issues in controller analysis and design. LQ analysis, H2 norm, LQR, LQG, uncertainty modeling, small gain theorem, H-infinity performance, and the mixed-norm H2/H-infinity problem. Prerequisite: ECE 6550. 3 credit hours
- AE 6532, Robust Control II – Advanced treatment of robustness issues. Controller analysis and design for linear and nonlinear systems with structured and non-structured uncertainty. Reduced-order control, stability, multipliers, and mixed-mu. Prerequisite: ECE 6531. 3 credit hours
- AE 6534, Control of AE Structures – Advanced treatment of control of flexible structures. Topics include stability of multi-degree-of-freedom systems, passive and active absorbers and isolation, positive real models, and robust control for flexible structures. Prerequisite: ECE 6230, ECE 6531. 3 credit hours
- AE 6580, Nonlinear Control – Advanced treatment of nonlinear robust control. Lyapunov stability theory, absolute stability, dissipativity, feedback linearization, Hamilton-Jacobi-Bellman theory, nonlinear H-infinity, backstepping control, and control Lyapunov functions. Prerequisite: ECE 6550. 3 credit hours
- AE 8803 THE, Nonlinear Stochastic Optimal Control 3 credit hours
- **ECE 6550*, Linear Systems and Controls – Introduction to linear system theory and feedback control. Topics include state space representations, controllability and observability, linear feedback control. Prerequisite: Graduate Standing. 3 credit hours**
- ECE 6551, Digital Controls – Techniques for analysis and synthesis of computer-based control systems. Design projects provide an understanding of the application of digital control to physical systems. Prerequisites: ECE 6550 Minimum Grade of D. 3 credit hours
- ECE 6552, Nonlinear Systems and Control – Classical analysis techniques and stability theory for nonlinear systems. Control design for nonlinear systems, including robotic systems. Includes design projects. Prerequisites: ECE 6550 Minimum Grade of D. 3 credit hours
- ECE 6553, Optimal Control and Optimization – Optimal control of dynamic systems, numerical optimization, techniques and their applications in solving optical-trajectory problems. Prerequisites: ECE 6550 Minimum Grade of D. 3 credit hours
- ECE 6554, Adaptive Control – Methods of parameter estimation and adaptive control for systems with constant or slowly varying unknown parameters. Includes MATLAB design

	projects emphasizing applications to physical systems. Prerequisites: ECE 6550 Minimum Grade of D. 3 credit hours • ECE 6555, Optimal Estimation – Techniques for signal and state estimation in the presence of measurement and process noise with the emphasis on Wiener and Kalman filtering. Prerequisites: ECE 6550 Minimum Grade of D. 3 credit hours • ECE 6559, Advanced Linear Systems – Study of multivariable linear system theory and robust control design methodologies. Prerequisites: ECE 6550 Minimum Grade of D. 3 credit hours • ECE 6563 Networked Control and Multiagent Systems • **ME 6401*, Linear Control Systems – Theory and applications of linear systems, state space, stability, feedback controls, observers, LQR, LQG, Kalman Filters. Prerequisite: ME 3015 or equivalent, or with the consent of the instructor. 3 credit hours** • ME 6402, Nonlinear Control Systems – Analysis of nonlinear systems, geometric control, variable structure control, adaptive control, optimal control, applications. Prerequisite: ME 6401 or equivalent, or with the consent of the instructor. 3 credit hours • ME 6403, Digital Control Systems – Comprehensive treatment of the representation, analysis, and design of discrete-time systems. Techniques include Z- and W- transforms, direct method, control design, and digital tracking. Prerequisite: ME 3015 or equivalent, or with the consent of the instructor. 3 credit hours • ME 6404, Advanced Control System Design and Implementation – Analysis, synthesis and implementation techniques of continuous-time and real-time control systems using classical and state-space methods. Prerequisite: ME 6403 or equivalent, or with the consent of the instructor. 3 credit hours
Perception	• **CS 6476*, Computer Vision – Introduction to computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding. Credit not awarded for both CS 6476 and CS 4495 or CS 4476. Credit will not be awarded for both CS 6476 and ME 6406. 3 credit hours** • CS 7476, Advanced Computer Vision – Advanced topics in computer vision, which includes a deep dive into both the theoretical foundations of computer vision to the practical issues of building real systems that use computer vision. Credit not awarded for CS 7476 and CS 7495. 3 credit hours • CS 7616, Pattern Recognition – This course provides an introduction to the theory and practice of pattern recognition. It emphasizes unifying concepts and the analysis of real-world datasets. 3 credit hours • CS 7636, Computational Perception – Study of statistical and algorithmic methods for sensing people using video and audio. Topics include face detection and recognition, figure tracking, and audio-visual sensing. Prerequisites: CS 4641 and (CS 4495 or CS 7495) 3 credit hours • CS 7499, 3D Reconstruction and Mapping – Course focuses on multi-robot/multi-camera mapping and reconstruction. Topics range from SLAM, graphical model inferences, and understanding the practical issues regarding multi-platform reconstruction. 3 credit hours • CS 7626 Behavioral Imaging – Theory and methods for measuring, recognizing, and quantifying social and communicative behavior using video, audio, and wearable sensor data. 3 credit hours • CS 7643 Deep Learning, Pre-req: CS 7641, 3 credit hours • ECE 6255, Digital Processing of Speech Signals – The application of digital signal processing to problems in speech communication. Includes a laboratory project. Prerequisites: ECE 4270 Minimum Grade of D. 3 credit hours • ECE 6258, Digital Image Processing – An introduction to the theory of multidimensional signal processing and digital image processing, including key applications in multimedia products and services, and telecommunications. Prerequisites: ECE 4270 Minimum

	Grade of D. 3 credit hours • ECE 6273, Pattern Recognition – Theory and application of pattern recognition with a special application section for automatic speech recognition and related signal processing. Prerequisites: ECE 4270 Minimum Grade of D. 3 credit hours • ECE 6560, PDEs in Image Processing and Computer Vision – Mathematical foundations and numerical aspects of partial-differential equation techniques used in computer vision. Topics include image smoothing and enhancement, edge detection, morphology, and image reconstruction. Prerequisites: ECE 6550 Minimum Grade of D. 3 credit hours • **ME 6406*, Machine Vision – Design of algorithms for vision systems for manufacturing, farming, construction, and the service industries. Image processing, optics, illumination, feature representation. Prerequisite: Graduate Standing in engineering or related discipline. Credit will not be awarded for both CS 6476 and ME 6406. 3 credit hours**
Artificial Intelligence	• **CS 6601*, Artificial Intelligence – Basic concepts and methods of artificial intelligence including both symbolic/conceptual and numerical/probabilistic techniques. Prerequisites: CS 2600** • CS 7612, AI Planning – Symbolic numerical techniques that allow intelligent systems to decide how they should act in order to achieve their goals, including action and plan representation, plan synthesis and reasoning, analysis of planning algorithms, plan execution and monitoring, plan reuse and learning, and applications. Prerequisites: CS 6601 • CS 7640, Learning in Autonomous Agents – An in-depth look at agents that learn, including intelligent systems, robots, and humans. Design and implementation of computer models of learning and adaptation in autonomous intelligent agents. Prerequisites: CS 3600 or CS 4641 • CS 7641 Machine Learning – Machine learning techniques and applications. Topics include foundational issues; inductive, analytical, numerical, and theoretical approaches; and real-world applications. Credit not awarded for CS 7641 and ME 8813. Prerequisites: CS 6601 • CS 7643 Deep Learning. Pre-req: CS 7641, 3 credit hours • CS 7648 Interactive Robot Learning, 3 credit hours. • CS 8803, Mobile Manipulation – The objective of the course is to gain knowledge of methods for design of mobile manipulation systems. The course covers all aspects of the problem from navigation and localization over kinematics and control to visual and force based perception. • CS 7649, Robot Intelligence Planning (previously CS 8803, Robot Intelligence: Planning in Action) – Course covers methods for planning with symbolic, numerical, geometric and physical constraints. Topics will range from classical and stochastic planning to continuous robot domains and hybrid control of dynamic systems. • CS 8803, Robot Motion Planning, 3 credit hours. • CS 8803, Computation and the Brain • CS 7642 Reinforcement Learning • CS 8803, Statistical Techniques in Robotics • CS 7751/ECE 7751, Graphic Models in ML (previously CS 8803, Probabilistic Graph Models and ML in High Dimensions) • ECE 6254, Statistical Machine Learning • ECE 6556, Intelligent Control – Principles of intelligent systems and their utility in modeling, identification, and control of complex systems; neuro-fuzzy tools applied to supervisory control; hands-on laboratory experience. Prerequisites: ECE 6550 Minimum Grade of D. 3 credit hours • **ME 8813*, Machine Learning Fundamentals for Mechanical Engineering - Introduction of machine learning methods and computational algorithms to solve mechanical engineering problems. Credit not awarded for CS 7641 and ME 8813. 3**

	Credit hours.
Human-Robot Interaction (HRI)	**HRI includes two core courses. Students are encouraged, but not required to take both HRI core courses. Students taking both core courses may use their second core class in place of an HRI elective course.** • **AE 6721*, Evaluation of Human Integrated Systems – Evaluation of human integrated systems including translating research questions into measurable objectives, overview of evaluation methods and data analysis techniques applicable to such systems. 3 credit hours** • **CS 7633*, Human-Robot Interaction – Survey of the state of the art in HRI research, introduction to statistical methods for HRI research, research project studio. A petition has been filed for this to be added to the permanent CS curriculum and have permanent course number. 3 credit hours** • CS 6455, User Interface Design and Evaluation – Qualitative empirical methods for understanding human-technology interaction. 3 credit hours • CS/PSYC 6750, Human-Computer Interact – Describes the characteristics of interaction between humans and computers and demonstrates techniques for the evaluation of user-centered systems. 3 credit hours • CS 7648 Interactive Robot Learning, 3 credit hours. • CS 8803 CSR, Computational Social Robotics 3 credit hours • ISYE 6215, Human-Machine Systems – The development and use of mathematical models of human behavior are considered. Approaches from estimation theory, control theory, queuing theory, and fuzzy set theory are considered. 3 credit hours • ISYE 6224, Human-Integrated Systems – State-of-the-art research directions including supervisory control models of human command control tasks; human-computer interface in scheduling and supervision of flexible manufacturing systems. 3 credit hours • PSYC 6011, Cognitive Psychology – Survey course on human cognition including pattern recognition, attention, memory, categorization, problem solving, consciousness, decision making, intention, and the relation between mind and brain. • PSYC 6014, Sensation & Perception – This course examines how sensations and perceptions of the outside world are processed by humans, including physiological, psychophysical, ecological, and computational perspectives. 3 credit hours • PSYC 6017, Human Abilities – Theory, methods, and applications of research on human abilities, including intelligence, aptitude, achievement, learning, aptitude treatment interactions, information processing correlates, and measurement issues. 3 credit hours • PSYC 7101, Engineering Psych I – Basic methods used to study human-machine systems including both system analysis and human performance evaluation techniques. These methods will be applied to specific systems. 3 credit hours • PSYC 7104, Psychomotor & Cog Skill – Human capabilities and limitations for learning and performing psychomotor and cognitive skills are studied. 3 credit hours
	**Subject to change

Additional Robotics Course listings

Note the above courses have been officially approved by the necessary GT governing entities as noted in the GT Catalog. Please see list of additional courses unofficially approved and anticipated offerings at: Robotics courses - all.docx. **.** (Note requires GT email address to access). This list is subject to change.

Current semester offerings are also available prior to start of Phase I registration and viewable at: https://oscar.gatech.edu/

Health and Wellness Resources

STAMPS health services offer a wide range of programs and services that can help students who may need assistance. The Wellness Empowerment Center site includes information on many stress-management services available on campus (e.g., yoga, mindfulness), as well as diet and lifestyle resources.

Questions about Student Health Insurance should be directed to Jennifer White at STAMPS at: jennifer.white@health.gatech.edu.

If a student just needs to talk to another graduate student who knows what they are going through, the Peer Coaching Program provides students with another way to receive support with their academic, social, and other concerns. Students are matched with a fellow Tech student who has been extensively trained to navigate mental health conversations and who is knowledgeable about campus resources.

Additional resources on campus that are there to assist graduate students include the Women's Resource Center, the LGBTQIA Resource Center and the Veteran's Resource Center.

During graduate school some students may experience health problems (sickness, injury, mental health, etc.), legal problems, or upsetting major life events, such as the death of a family member. In addition, some students find that they are unable to cope effectively with the stresses they encounter while in graduate school. Students in these situations are encouraged to take advantage of on- or off-campus resources for managing either general stress or specific problems. The following is a list of some available resources for graduate students:

Counseling Center www.counseling.gatech.edu

Professional counselors are available to consult confidentially with students about any issue, whether personal or school-related.

Dean of Students www.deanofstudents.gatech.edu

The Dean of Students office advocates for students in handling missed classes and making up work due to sickness, injury, and other adversities. If you experience a problem that interferes with classes for more than a few days, you should contact the Dean of Students office for advice and assistance.

National Graduate Crisis Line 1.877.GRAD.HLP (1.877.472.3457)https://gradresources.org/crisis/

An off-campus, non-profit center for graduate students in crisis that is available 24/7.

In a small number of cases a health problem or life event may be so significant that it prevents a student from making progress in classes or research. In these extreme cases it may make sense to consider a leave of absence, and students should discuss the situation candidly with their advisor,

Associate Chair for Graduate Studies in their home unit, ROBO Program Manager, and/or the Dean of Students office.

Put the Georgia Tech Police number in your phone (404-894-2500) to call for any safety concerns. Call 911 for emergencies.

The bottom line: if you need help with anything, please ask! There are many resources available to ensure your Ph.D. experience is all you want it to be.