

Mathematical Physics

Course Information

- **Instructor:** Surabhi Sachdev (ssachdev38@gatech.edu)
- **Course Prefix and Number:** PHYS 3151
- **Term:** Fall 2026
- **Credits:** 3 credit hours

Course Description

As undergraduates interested in physics, you've been building an understanding of the fundamental theories that govern the natural world through courses in classical and quantum mechanics, electromagnetism, thermodynamics, relativity, and possibly atomic physics.

This course provides a review of the mathematical techniques used to describe physical systems in these areas. Taking a “physics-first” approach, we will sketch key results (without aiming for full mathematical rigor) and emphasize practical examples that illustrate how mathematics is applied to real-world physics problems.

Course Learning Outcome

- Mathematical formulation of physical problems
 - Demonstrates ability to translate physical phenomena into mathematical language
 - Shows understanding of how mathematical models can be used to describe and predict physical behavior
- Linear algebra and eigenvalue problems
 - Demonstrates proficiency in linear algebra techniques, including matrix operations, eigenvalues, and eigenvectors
 - Applies linear algebra concepts to solve problems in quantum mechanics and other areas of physics
- Complex analysis and contour integration
 - Shows understanding of complex analysis concepts, including analytic functions, Cauchy's integral theorem, and residue calculus
- Fourier analysis and transforms

- Demonstrates ability to perform Fourier analysis and apply Fourier transforms to solve problems in physics, such as signal processing and wave phenomena
- Physical interpretation
 - Shows ability to interpret mathematical results in the context of physical phenomena
 - Demonstrates understanding of the physical significance of mathematical techniques and results
- Problem-solving and approximation
 - Demonstrates ability to apply mathematical techniques to solve complex physics problems
 - Shows understanding of approximation methods and their applications in physics, such as perturbation theory and variational methods

Required Course Materials

Mathematical Methods for Physicists by Arfken, Weber, and Harris, 7th Edition, available as hardcover or eBook.

Grading Policy

	Component	Weight
Graded Components	Homework	30%
	Exam 1	20%
	Exam 2	20%
	Final	25%
	Class participation	5%

	Grade	Range
Final Letter Grades	A	90–100%
	B	80–89%
	C	70–79%
	D	60–69%
	F	59% and below

Exam Policy There will be two exams during the semester and a final at the end. All exams will be held in person during our regularly scheduled class time unless we have a different agreement. See the schedule for the exam dates. If you have a medical excuse or absence due to an approved Institute activity, you must contact me as soon as possible to make an alternative arrangement for a missed exam. In all cases, you may not look at the exam of anyone else.

Homework Policy There will be roughly 10 homework sets over the course of the semester. Homework sets will be due Thursday at 11:59pm, with one exception: the final homework set of the semester is due on **Tuesday, December 1 at 11:59pm**, so that solutions can be posted with enough time for you to use them while studying for the final exam. Unless you make special arrangements with me before the assignment is due, we will use the following late assignment policy: 75% of earned credit will be given for late assignments turned in within 24 hours from the due time, 50% within 48 hours, 25% within 72 hours, and zero credit beyond this point. If you have a medical excuse or absence due to an approved Institute activity, you must

contact me as soon as possible to arrange a new due date for your assignment. In all cases, you may not look at the homework of anyone else. No assignments will be accepted after solutions have been disclosed.

You will submit your homework in electronic form using Canvas. The homework can be handwritten on paper and scanned, just make sure that your scan is of sufficient quality to allow me/your TA to read it. For each homework assignment, only one submission will be accepted from each student. Please write your homework solutions in a clear and legible manner, following the order in which the problems are given. Homework and exams will be graded using the following rubric (based on an example of a problem worth 10 points):

10 points – correct and complete solution; **9 points** – small math error; **8 points** – small physics error; **5 points** – major physics error; **2 points** – minimal progress.

Working in a group can help in understanding the homework questions and is encouraged. The work you submit however must be your own. Failure to do so will mean a 0% on that assignment and is a violation of the student honor code.

Class Participation Class participation will be assessed in about 15–20 in-class assignments. The assignments will be short (about 5 minutes) calculations carried out by students during class time and designed for the practice of the newly learned concepts. Every reasonable attempt at a solution will earn full credit (i.e., no penalty for incorrect solutions). You can submit your handwritten in-class calculations on a piece of paper at the end of the lecture.

Attendance Policy

This course will be delivered in-person. You are expected to attend the class sessions unless you have a compelling reason not to do so. Note that there is a class participation component of the course (see Grading Policy above).

Academic and Research Honesty/Integrity Statement

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review the [Student Code of Conduct](#) and the [Academic Honor Code](#), especially [Appendix A: Graduate Addendum to the Academic Honor Code](#).

Students are expected to perform research in an ethical and responsible manner.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Allegations of scientific or scholarly misconduct are handled in accordance with the procedures outlined by the [Policy for Responding to Allegations of Scientific or Other Scholarly Misconduct](#).

Core IMPACTS

Not applicable

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, [contact the Office of Disability Services](#) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgment, and responsibility between faculty members and the student body. [The Student-Faculty Expectations](#) articulates some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.