# Physics 1373/2373: Mathematical Methods in Physics

## Fall 2025

- Recommended textbooks:
  K. Riley, M. Hobson and S. Bence: "Mathematical Methods for Physics and Engineering," 3rd edition
  G. Arfken, H. Weber and F. Harris: "Mathematical Methods for Physicists," 7th edition
- Pre-/Co-requisites: Physics 1370
- Lectures: TH 9:30-10:45am (5201 Posvar Hall)
- Office hours: W 2:00-4:00pm (403 Allen Hall) or by appointment

## Course description

In this class, students will learn about the mathematical tools that are essential for various branches of physics. The class is suitable for undergraduate students planning to go on to graduate school and for first-year graduate students. The lecture will discuss a range of mathematical and calculational methods with a "practical" mindset, *i.e.* it is less formal than a comparable course in the math department. While the focus lies on the mathematics, I will try to often show examples of applications in physics.

Learning objectives: Students completing this course will acquire the ability to

- understand linear algebra and vector spaces as they are applied in physics and other mathematical problems (e.g. differential equations);
- employ vector calculus to efficiently describe physics problems in 2 and 3 dimenions;
- compute and apply Fourier and Laplace transforms;
- solve a variety of ordinary and partial differential equations using a range of techniques;
- exploit the properties of special functions in the solution of physics problems;
- analyze the analytic properties of complex functions and use them to help compute integrals;
- use the calculus of variations for problems in classical and quantum physics;
- understand and evaluate the fundamental statistics underlying all physical measurements.

The recommended textbook for this course is "Mathematical Methods for Physics and Engineering" by K. Riley, M. Hobson and S. Bence. I admit that this book is pretty massive, but it covers all relevant topics and not assume that the reader has any advanced knowledge in mathematics.
An alternative good book is "Mathematical Methods for Physicists" by G. Arfken, H. Weber and F. Harris, which is more concise and jumps rights into the "real stuff", but it makes a good reference.
Both books are available through the Pitt Science&Engineering library (according to my information, a physical copy for Riley and electronic access for Arfken).

This course is offered to undergraduate and graduate students. While the lecture is the same for everybody, the homework assignments and exams will differ for students enrolled in PHYS 1373 (undergraduate level) and PHYS 2373 (graduate core course). Each homework sheet will indicate which problems are required for students of PHYS 1373, while the remaining problems are voluntary

(for extra credit). Students of PHYS 2373 are expected do all problems on each homework assignment. **Note:** Physics graduate students must enroll in PHYS 2373.

## Readings and in-class activities

This course covers a wide area of mathematical topics, some of which you may be more familiar with than others. To make the course as useful for everybody as possible, I will not hold lectures in the traditional style, but instead I will post lecture notes and weekly reading assignments (from either of the two suggested textbooks) on Canvas. You are required to read these materials outside of class time, complete the short quiz provided, and come to class prepared.

The class time will be used to go through worked examples, discuss questions, and for in-class problems, which you will solve in small groups. The flow of these activities is flexible, so that I can adjust them according to your progress and feedback. Your participation in these activities is important, and although I will not check attendance, you should come to class regularly.

## Homework

Homework is an essential part of learning the material of this course. Homework will be assigned each week on Thursday and collected next week on Thursday. You are encouraged to discuss the homework problems with each other after you have tried them to the best of your ability, but you cannot copy the solutions from each other. The homework assignments and solutions will be available for download on Canvas.

Some of the homework problems will be discussed in class (after they have been graded and returned). For this purpose I will occiasionally pick one student at random to present her/his solution on the board. In this way, you can learn from each other's solutions, and also practice your presentation skills.

## Grading scheme

There will be one mid-term exam and a comprehensive final exam. The dates for the exams will be announced several weeks in advance. The final grade will be determined by the homework submissions (30%), and mid-term (25%) and final exam (45%).

## Academic policies

### Academic integrity

Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators.

To learn more about Academic Integrity, visit the Academic Integrity Guide for an overview of the topic. For hands- on practice, complete the Academic Integrity Modules.

**Disability resources**

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services, 140 William Pitt Union, (412) 648-7890, drsrecep@pitt.edu, (412) 228-5347 for P3 ASL users, as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

**Copyright and recording**

Course materials provided by the instructor through Canvas or some other means may be protected by copyright. United States copyright law, 17 USC section 101, et seq., in addition to University policy and procedures, prohibit unauthorized duplication or retransmission of course materials.

To ensure the free and open discussion of ideas, students may not record classroom lectures, discussion and/or activities without the advance written permission of the instructor, and any such recording properly approved in advance can be used solely for the student's own private use.