Physics 1373/2373—Mathematical Methods Fall Term 2024-2025
5201 Wesley W. Posvar Hall Tuesday & Thursday 9:30-10:45
Instructor: Professor Joseph Boudreau (boudreau@pitt.edu)
Office 418 Allen Hall
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Corequisite: Physics 1370 (Intro Quantum Mechanics I) or special permission

Zoom meeting room: 940 2179 1773 for class as necessary (see below)
478 805 8218 for office hours as necessary.

Office hours Thursday 2:00-5:00 PM

Physics 1373/2373 aims to provide students with a foundation in the mathematical techniques needed in advance physics courses and in the physics literature. Specific topics that will be covered include: ordinary and partial differential equations, Sturm-Liouville theory, special functions, Green's functions, complex analysis, and group theory.

Learning objectives: Upon completing the course students will have acquired the ability to

- Solve first and second order differential equations using a variety of techniques.
- Recognize and be familiar with a variety of special functions occurring in classical electromagnetism and quantum mechanics.
- Use Green's functions to solve inhomogeneous ordinary and partial differential equations.
- Recognize the commonality in numerous orthogonal functions arising in physics and exploit their properties in the solution of a variety of problems.
- Determine the analytic properties of functions of a complex variable.
- Use Cauchy's residue theorem and apply the calculus of residues.
- Recognize some important groups that arise in physics, describe important properties of their representations and understand their role in quantum mechanics.

While many of these skills are learned in the context of specific advanced physics courses, in this course we survey and observe commonality in the mathematical techniques that extend across multiple applications in physics.

Special provisions for fall semester 2024:

Several dates will require remote instruction. On the following days:

September 12, 17, 19 the course will be delivered over zoom due the instructor's required presence at remote sites. A special classroom, David Lawrence Hall Room 21, equipped with state-of-the-art video equipment will be reserved during these days. **November 5 (election day)** the university mandates remote classes. In all cases, students are encouraged to attend and interact normally, but for convenience the lectures will also be recorded.

The textbook for the course is

- *Mathematical methods for physicists, a comprehensive guide*, George B Arfken, Hans J. Weber, and Frank E. Harris. 7th Ed. This is available in the Engineering Library; online copies are available through the PittCat library system. This book is worth having on your shelf since it will be an invaluable reference for future work you do in the field of physics or other STEM fields

The course is divided into three topical segments: Differential equations, Complex Analysis, and Group Theory. An exam will be given after each segment. Each exam is worth 25% of the course grade. The format of the exam will be announced and may include in-class, take-home, or online examination. Homework, assigned each week should be turned in, either handwritten, printed out or electronically submitted. It is worth 25% of the grade.

The **first exam** will be held on Thursday Oct 17. The second **exam** will be held on Tuesday Nov. 12. The **third exam** will be held on Tuesday Dec 10). There is no final exam.

Provisional list of reserve material: During COVID, the library will not maintain reserve materials. However, the University Library system has electronic copies that may be accessed either directly or indirectly via PittCat (library.pitt.edu). This list may expand as the semester progresses.

Generic resources:

- *Mathematical Methods for Physics and Engineering*, 3rd Edition, K. Riley, M. Hobson and S. Bence (2006, Cambridge University Press). Available at the reserve desk of the Engineering library and online through PittCat
- *Mathematics for Physicists*, Philippe Dennery and André Krzywicki (Dover Editions 1967, 1996). Available at the reserve desk of the Engineering Library. Also available through archive.org.
- *Lie Algebras in Particle Physics, From Isospin to Unified Theories,* 2nd Edition, Howard Georgi, (Westview Press, 1999) Available at the reserve desk of the Engineering Library.

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 GuideLinks to an external site. for an overview of the topic. For hands-on practice, complete the Understanding and Avoiding Plagiarism tutorial.

Disability Services

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 (DRS), 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.