Physics 1373/2373—Mathematical Methods Fall Term 2021-2022
11 Thaw Hall Tuesday & Thursday 9:30-10:45
Instructor: Joseph Boudreau (boudreau@pitt.edu)
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Zoom meeting room: 933 8592 4385 for class as necessary
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 2021:

All university-wide directives regarding the campus response to the COVID pandemic will be adhered to within the classroom. Experience has shown that these are subject to change. We start the semester with a flexible arrangement which allows students to attend the class remotely using the zoom link mentioned at the top of this syllabus. This is not expected to past the second week of class, but the situation so far has yielded very many surprises.

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 electronically. It is worth 25% of the grade.

The **first exam** will be held on Wed Oct 6. The second **exam** will be held on Wed Nov. 10. The **third exam** will be held during the week of Dec 13.

Academic Integrity: Working with other students on homework is highly conducive to learning and is encouraged, but on exams you must work alone. The list of external "resources" for problem solving is long and diverse and ranges from calculators, to tables of integrals, computer algebra systems like Mathematica, Wikipedia articles, the full solution manual, and even organized rackets that tacitly or actively promote cheating. On one end of this spectrum one finds important resources that facilitate learning, and on the other end one finds invitations to clear academic integrity violation. In the middle is a gray zone. Please use your judgement or ask the instructor if in doubt. Do not submit work that has been copied from another source. Stay honest, and figure it out for yourself. The academic integrity policy of the University of Pittsburgh can be found at http://www.cfo.pitt.edu/policies/policy/02/02-03-02.html.

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.

Students with disabilities: 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/(412) 383-7355 (lTY), as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course