

Physics 428 – Methods of Mathematical Physics
Fall 2024
TR 5:50 – 7:05 pm

Instructor:

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Office hours: By appointment. You are expected to have at least two office hours. You will get a reusable Google doc link to schedule office hours and other meetings.

Mode of Lecture: In-person.

Note: All links, homework assignments, and exams will be share on the coursesite. A copy of this syllabus can also be accessed on the coursesite.

Required Textbook:

Arfken, Weber, and Harris, Mathematical Methods for Physicists – A Comprehensive Guide, 7th edition, Elsevier Inc.

Other reading materials that you may also find helpful:

J. Mathews & R. L. Walker, Mathematical Methods of Physics, W.A. Benjamin

F.W. Byron & R.W. Fuller, Mathematics of Classical and Quantum Physics, Addison-Wesley

P. Goldbart & M. Stone, Mathematics for Physics: A Guided Tour for Graduate Students, Cambridge University Press

Homework:

Homework will be assigned on weekly basis. The homework assignments are designed for learning than for grades. Homework will be graded on efforts rather than just the correct answer. As such, I encourage you to work as a diverse team and with each other on the homework assignments. I am just a click away, and you are welcomed to schedule office hours as often as needed if you need help. You must turn in the homework assignments to receive a passing grade in the course. Late homework without any valid reason will be penalized by 10% per day. If for any reason you are not able to the complete homework assignments on time, please, reach out to me as soon as you can. All homework assignments

are due Thursdays before class and will be submitted in a Portable Document Format (PDF) through a link on Dropbox that I will share with you each week.

Exams:

There is no collaboration of any kind on exams. Various forms of exams will be designed all with the high integrity expected of each of us. There will be a blend of synchronous and take home exams. The use of any materials not explicitly permitted will be considered as a form of cheating. Such act will be referred to the Disciplinary Committee. Anyone caught in the act may earn a grade of zero in the exam.

Class Attendance:

Attendance is strongly recommended but not required.

Grading will be determined as follows:

Homework	–	30%
Exam 1	–	20%
Exam 2	–	20%
Final Exam	–	30%

Grading Scale: **A**= 88-100; **B**= 75-87; **C**= 60-74; **D**= 50-60

Feedback:

Come and talk to me about anything you may be struggling with and give me your honest feedback! This can help me readjust the course and address specific areas that might not be familiar to some of you.

Topics Covered¹:

1. Mathematical Preliminaries (Ch. 1)
 - Infinite series
 - Binomial theorem and Mathematical induction
 - Vectors, Complex numbers and functions
 - Derivatives and Extrema
 - Evaluation of integrals
2. Ordinary Differential Equations (ODE) (Ch. 7)
 - Orders of ODE – First and Second order linear ODE
 - Series solutions
 - Inhomogeneous linear ODE
 - Nonlinear differential equations

¹This syllabus is only a tentative outline of the course. Topics covered in class may change as needed.

3. Sturm Liouville Theory (Ch. 8)
 - Hermitian Operators
 - ODE eigenvalue problems
 - Variational method
4. Partial Differential Equations (PDE) (Ch. 9)
 - Orders of PDE – First and Second order PDE
 - Separation of variables
 - Laplace and Poisson equations
 - Diffusion PDE
5. Green's Functions (Ch. 10)
 - Physical meaning of Green's function
 - Problems in spatial dimensions
6. Complex Analysis (Ch. 11)
 - Complex variables and functions
 - Cauchy-Riemann and Cauchy integral theorem
 - Laurent expansion
 - Calculus of residues
 - Definite integrals and their evaluation
7. Special Functions (Ch. 13-15)²
 - Gamma function
 - Bessel functions
 - Legendre functions

Class and University Policies

Accommodation for Students with Disabilities:

Lehigh University is committed to maintaining an equitable and inclusive community and welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact Disability Support Services (DSS), provide documentation, and participate in an interactive review process. If the documentation supports a request for reasonable accommodations, DSS will provide students with a Letter of Accommodations. Students who are approved for accommodations at Lehigh should share this letter and discuss their accommodations and learning needs with instructors as early in the semester as possible. For more information or to request services, please contact Disability Support Services in person in Williams Hall, Suite 301, via phone at 610-758-4152, via email at indss@lehigh.edu, or online at <https://studentaffairs.lehigh.edu/disabilities>.

²If time permits

The Principles of Our Equitable Community:

Lehigh University endorses The Principles of Our Equitable Community http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

Academic Integrity/Code of Conduct:

It is our shared fundamental responsibility to promote and ensure academic integrity. Collaborate with other students is strongly encouraged and any group with more diversity in their team will have an extra day to turn in their homework assignments. Referencing out-side materials for homework assignments are encouraged but verbatim copying including from each other is considered plagiarism. Any student found to have engaged in academic misconduct on a graded assignment or exam may be assigned a grade of zero, assigned an F in the course, and will be referred to the Disciplinary Committee. The vignettes are available at <http://www.lehigh.edu/lts/official/Academic Integrity Vignettes.pdf>.