

PHYSICS 434 / 534 METHODS OF MATHEMATICAL PHYSICS: Winter 2024
In Person only

Instructor: Dr. Andy Martwick, martwick@pdx.edu, text & voice 503 333 8285

Office Hours: After class or by arrangement Can meet by zoom almost anytime, including evenings.

Class: MW hours 12:00 – 13:50

Textbook: Physical Mathematics, Kevin Cahill - **Second Edition preferred but First Edition will work**

Additional Reference: Mathematical Methods for Physicists, Arfken and Webber. Cahill has lectures for his book posted at <http://quantum.phys.unm.edu/466-19/>

Course Description –This class is a survey of methods of applied mathematics used in physics mainly following Cahill chapters 1-5 in first edition, chapters 1-6 in the second edition. Outside reference material may be required.

Outline:

1. Ch1-Linear Algebra topics includes Vector Spaces, Dirac Notation, Operators, Eigenvectors, matrices, basis transformations. Spin vector space.
2. Ch2 from 2nd edition (is not in first edition) - A short vector calculus review, Levi-Civita cross product, and vector identities derived with Levi-Civita.
3. Ch5- Infinite series, Laurent series, power series
4. Ch6- Complex analysis and complex integrals, real integrals in the complex plane
5. Ch3- Fourier series solutions to differential equations, Dirac delta functions
6. Ch4- Fourier and Laplace transforms with circuit examples, inverse transforms using complex analysis

Homework: There will ~four homework assignments. Assignments will be sent by email. Complete problems will be sent. They are due on Wednesdays prior to the end of class, see the schedule. Some problems may require outside physics reference material. All homework counts. Each homework assignment is 10% of your final grade. This quarter we will have HW sessions on Wednesday.

534 students will have additional homework and exam problems

Late Homework: One week at 80%, then no credit. Please stay up on your homework. Exceptions will be made for exceptional circumstances if you contact me prior to the due date.

Exams: Exams will be open book, open notes. If you have not done the homework, open book will not help you. One page of (8 ½ x 11) notes is allowed. Exams will be based on the homework.

Grading

Homework 40% Midterm 30% Final 30%

Suggested Pre-requisites:

Physics 201–203/211–213: General physics

Physics 311-312: Modern physics

Mathematics 251–253: Calculus I-III

Mathematics 256: Differential equations and multivariate calculus

Absence due to sickness –You will not be penalized for illness-related absences or unforeseen emergencies. If this occurs contact me and let me know.

Attendance and Participation:

Attendance will be taken and will count for your final grade. It is important to attend and participate as much as possible.

Course Schedule (tentative)

Week	Topics, Readings, Assignments, Deadlines
1	Day 1: Complex numbers 1.1 and vector spaces 1.4 Day 2: Arrays 1.2, Matrices 1.3, Linear Operators 1.5, Inner Products 1.6, Inequality 1.7
2	Day 3: MLK Holiday Day 4: Linear Independence, Dimensions, Orthonormal, Outer products, Dirac notation, Operators 1.8-16
3	Day 5 or 6: Determinants 1.20, Eigenvector / value 1.25, zero space, basis transforms Day 5 or 6: Ch2. Vector Calculus review 2.1-2.3, line integrals, Stokes theorem, curl and Levi-Civita proofs - Homework 1 due: Chapter 1
4	Day 7: More Levi-Civita proofs. Summary of Linear algebra, linear vector spaces, HW questions Day 8: Convergence, 5.1-5.3. Taylor series 5.7, Binomial series 5.9, analytic functions 6.1
5	Day 9: CR tests, 6.2, integral thm and integral formula 6.2-6.4 Day 10: Taylor series 6.6, Fundamental thm, Laurent series, Singularities, 6.9-6.11 Homework 2 due Chapter 2, 5
6	Day 11: Calculus of residues 6.13, real integrals in complex plane Day 12: Day 12: Midterm Ch 1, 2, 5
7	Day 13: Real Integrals Day 14: Fourier series, 3.1 – 3.4
8	Day 15: Intervals 3.5, First order diffy eq and Fourier series solutions Day 16: Dirac Delta 3.11, Fourier xforms of functions 4.1 & 4.2 Homework 3 due: Chapter 6 & 3
9	Day 17: Laplace 4.6-4.8 Day 18: More Laplace
10	Day 19: Graduate topics Day 20: Review Homework 4 due, Ch 4
Final Exam	Chapters 6, 3, 4

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Access and Inclusion for Students with Disabilities

PSU values diversity and inclusion; we are committed to fostering mutual respect and full participation for all students. My goal is to create a learning environment that is equitable, useable, inclusive, and welcoming. If any aspects of instruction or course design result in barriers to your inclusion or learning, please notify me. The Disability Resource Center (DRC) provides reasonable accommodations for students who encounter barriers in the learning environment.

If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations. The DRC is located in 116 Smith Memorial Student Union, 503-725-4150, drc@pdx.edu, <https://www.pdx.edu/drc>.

If you already have accommodations, please contact me to make sure that I have received a faculty notification letter and discuss your accommodations.

Students who need accommodations for tests and quizzes are expected to schedule their tests to overlap with the time the class is taking the test.

Title IX Reporting Obligations

As an instructor, one of my responsibilities is to help create a safe learning environment for my students and for the campus as a whole. Please be aware that as a faculty member, I have the responsibility to report any instances of sexual harassment, sexual violence and/or other forms of prohibited discrimination. If you would rather share information about sexual harassment, sexual violence or discrimination to a confidential employee who does not have this reporting responsibility, you can find [a list](#) of those individuals or contact a confidential advocate at 503-725-5672. For more information about Title IX please complete the required student module [Creating a Safe Campus](#) in your D2L.