



## Physics 571

### Mathematical Methods in Physics

Tuesday and Thursday, 9:45 to 11:00 AM,

Nielsen Physics Building, Room P304.



Prof. Cristian D. Batista

210 South College

Office Hours: Tuesday and Thursday 3:00 PM to 4:00 PM

Email: [cbatist2@utk.edu](mailto:cbatist2@utk.edu)

Phone: (865) 974-4164

Zoom: <https://tennessee.zoom.us/j/4991007715>

Canvas: we will use canvas as the primary medium of communication

**Course Description:** This course will expose you to the mathematical concepts underlying modern physics. Our goal is to not only make you proficient with the mathematical methods needed for success in physics research, but to also expose you to ideas that have been used for a rigorous, abstract and advanced reformulation of several fields of physics, including classical mechanics, electromagnetism, quantum theory, relativity and statistical mechanics. Engineering, computer science and data science fields also use many of the mathematical techniques that we will discuss.

**Prerequisites:** There are no formal prerequisites for this course; however, I will assume that you have a background in linear algebra and single- and multivariable calculus, including some familiarity with concepts related to ordinary differential equations. Experience with these topics is highly recommended and necessary for success in this course. You do not have to be an expert in the material, but you should have taken these classes, or you should get the relevant textbooks and teach yourselves as needed.

### Contents

1. *Vectors and matrices.* Linear vector spaces, Subspaces, Linear Operators, Matrices, Coordinate Transformations, eigenvalue problems, diagonalization of matrices, spaces of infinite dimensionality.
2. *Evaluations of integrals.* Elementary methods, use of symmetry arguments.
3. *Integral transforms.* Fourier series, Fourier transforms, Laplace transforms.
4. *Complex analysis.* Cauchy-Riemann equations. Complex integration. Applications of Cauchy's theorem. Contour Integration technology. Applications. Saddle-point methods.

5. *Partial differential equations*. Examples. General discussions. Separation of variables.
6. *Eigenvalues, eigenfunctions and Green's functions*. Simple examples of eigenvalue problems, general discussion, solutions of boundary-value problems as eigenfunction expansions inhomogeneous problems. Green's functions, and Green's functions in Electrodynamics.

**Main text:** Mathematical Methods of Physics, Mathews and Walker.

**Additional texts:**

**Undergraduate level textbooks**

- Advanced Engineering Mathematics, Erwin Kreyszig.
- Introduction to Linear Algebra and Differential Equations, John D. Dettman.
- Linear Algebra, S. Lang.
- Elementary Linear Algebra, Howard Anton and Chris Rorres.
- Fourier Series, Georgi P. Tolstov.
- Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson, and S. J. Bence.
- Advanced Calculus of Several Variables, C. H. Edwards.

**Graduate level textbooks**

- Mathematical Methods in Physics and Engineering, J. W. Dettman.
- Mathematics of Classical and Quantum Physics by Frederick W. Byron and Robert W. Fuller.
- Mathematical Methods for Physicists, Arfken and Weber
- Mathematics for Physics, A guided Tour for Graduate Students, M. Stone and P. Goldbart.

**Grade Distribution:**

Homework	30%
Midterm Exam	30%
Final Exam	40%

**Course Policies:**

- **General**
  - Computers are not to be used unless instructed to do so.
  - Quizzes and exams are closed book, closed notes.
  - **No makeup quizzes or exams will be given.**

- **Grades**

- Grades in the **C** range represent performance that **does not meet expectations**; Grades in the **B** range represent performance that **meets** the expectations; Grades in the **A** range represent work that is **excellent**.
- Students are responsible for tracking their progress by referring to the online gradebook.

- **Assignments**

- Students are expected to work independently. **Offering** and **accepting** solutions from others is an act of **plagiarism**, which is a serious offense and **all involved parties will be penalized according to the Academic Honesty Policy**. Discussion among students is encouraged, but when in doubt, direct your questions to the professor.
- **If you turn in the homework late, then I will reduce the mark by 50% for each 24-hour period it is overdue unless you have made prior arrangements with me.**

- **Academic honesty and integrity:** By taking this course, you agree to the following statement: “An essential feature of the University of Tennessee, Knoxville is a commitment to maintaining an atmosphere of intellectual integrity and academic honesty. As a student of the university, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my own personal commitment to honor and integrity.”

All work submitted by a student is expected to represent his/her work. Students are expected to complete their homework without assistance from others. Students are expected to perform all work in conformance with the University policies regarding Academic Honesty. I will pursue any cases of academic dishonesty that arise during the course.

- **Students with disabilities:** Any student who feels they may need an accommodation based on the impact of a disability should contact Student Disability Services in Dunford Hall, at 865-974-6087, or by video relay at, 865-622-6566, to coordinate reasonable academic accommodations.

- **University civility statement:** Civility is genuine respect and regard for others: politeness, consideration, tact, good manners, graciousness, friendliness, affability, amiability and courteousness. Civility enhances academic freedom and integrity and is a prerequisite to the free exchange of ideas and knowledge in the learning community. Our community consists of students, faculty, staff, alumni, and campus visitors. Community members affect each other’s well-being and have a shared interest in creating and sustaining an environment where all community members and their points of view are valued and respected. Affirming the value of each member of the university community, the campus asks that all its members adhere to the principles of civility and community adopted by the campus: <http://civility.utk.edu/>.