

PHY 301 – Electromagnetism

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Course Description

This course introduces the fundamental principles of classical electromagnetism through Maxwell's theory. Emphasis is placed on physical intuition, mathematical methods, and the unification of electricity, magnetism, and light. Applications to modern technologies, including medical imaging, communications, particle accelerators, and photonics, are discussed throughout the course.

Textbook

D. J. Griffiths, *Introduction to Electrodynamics*, 5th Edition, Cambridge University Press.

Course Outline

1. Mathematical Tools

- Vector algebra and vector calculus
- Coordinate systems
- Gauss' and Stokes' theorems

2. Electrostatics

- Coulomb's law
- Electric fields and potentials
- Gauss' law
- Conductors and capacitance

3. Electric Fields in Matter

- Polarization
- Dielectrics
- Electric displacement

4. Electric Currents

- Current density
- Ohm's law
- Continuity equation

5. Midterm Examination

6. Magnetostatics

- Lorentz force
- Biot–Savart law
- Ampère's law
- Vector potential

7. Maxwell's Equations

- Displacement current
- Maxwell's equations
- Boundary conditions

8. Electromagnetic Waves

- Wave propagation
- Polarization
- Energy transport

9. Modern Applications

- MRI and medical imaging
- Optical fibers and photonics
- Wireless communication
- Particle accelerators

10. Review

11. Final Examination

Learning Outcomes

Upon successful completion of the course, students will be able to

- Apply vector calculus to electromagnetic fields.
- Solve elementary electrostatic and magnetostatic problems.
- Explain the physical content of Maxwell's equations.
- Analyze electromagnetic waves in vacuum and simple media.
- Recognize the role of classical electromagnetism in modern science and technology.

Assessment

Homework	20%
Midterm Examination	40%
Final Examination	40%