

General Physics III. Electromagnetism

1 Lecture times

- Mon: 14:00-16:00
Tues: 13:00-15:00
- Exercises
Wed: 8:00-10:00am

2 Course content:

The course covers the phenomena, concepts, principles, and formalism of electricity and magnetism. The unity of the electric, magnetic, and optical phenomena is emphasized. A conceptual understanding (physical intuition) of the subject and the mathematical concepts underlying the formalism of electromagnetism will be covered.

3 Instructor information

- Instructor: Prof. G. R. Ramirez-San Juan.
- Teaching assistants: Each exercise section has a team of two graduate student instructors and four student assistants. The graduate student instructors that are the primary instructors of each /exercise section are as follows.

CE 1 104	CM 1 106	CM 1 105	CE 1 106
Benedetta Noferi	Chinmaya Venkatesh	Andrea Lizzit	Hanning Zhang
		Giulio Carotta	Inés Tomas Soler

4 Course exercise sheets

There will be an exercise sheet for every week of the course. The exercise sheets will be posted on Moodle one week before the session in which they are discussed, except for Week 1, whose sheet will be provided on the first day of class. The solutions to each sheet will be uploaded when the next sheet is posted.

5 Course Materials

Course materials such as lecture notes, links to class recordings, and additional readings are provided on moodle as a courtesy and at the discretion of the instructor.

6 Grading

- 100% of your grade will be the written final exam, which will be held in January 2026. Detailed information on the exam content and logistics will be provided to you in early December. The exam will be 3 hours long and consist of three open-ended problems and 35 multiple choice questions.

7 Course content

These are the topics that will be covered during the course.

- Week 1.** Lecture 1. Course Introduction and Review of Vector Calculus
Lecture 2. Electric charge and Coulomb's law
- Week 2.** Lecture 3: The Electric Field. Gauss's law and its applications.
Lecture 4: Gauss's law revisited. The electric potential.
- Week 3.** No class
Lecture 5: Poisson and Laplace's equations.
- Week 4.** Lecture 6: Conductors
Lecture 7: Capacitance and capacitors
- Week 5.** Lecture 8. Multipole expansion. Dipole moments.
Lecture 9. Electric fields in matter I.
- Week 6.** Lecture 10: Electric Fields in matter II.
Quiz electrostatics
- Week 7.** Break
- Week 8.** Lecture 11: Current, continuity equation, Ohm's law.
Lecture 12: EMF, Circuits, Kirchhoff's Rules
- Week 9.** Lecture 13: Magnetostatics I. Lorentz force law.
Lecture 14. Magnetostatics II. Biot-Savart and Ampere's laws.
- Week 10.** Lecture 15: Magnetic vector potential.
Lecture 16: Magnetic fields in matter I. Mechanisms of magnetization.
- Week 11.** Lecture 17: Magnetic fields in matter II. Ampere's law in magnetized materials.
Lecture 18: Electromagnetic Induction. Faraday's law.
- Week 12.** Lecture 19: Inductance and magnetic energy.
Lecture 20: Circuits with AC sources.
- Week 13.** Lecture 21: Maxwell's equations.
Lecture 22: Electromagnetic waves.
- Week 14.** Lecture 23: Energy and momentum carried by electromagnetic waves
Lecture 24: Special relativity.
- Week 15.** Lecture 25: Exam review session
Quiz magnetostatics

8 Bibliography

All of the course content is taken from the Purcell and Griffiths textbooks referenced below. You can find a pdf of these textbooks on moodle. The course does not follow that Feynmann book, but it is a great book to read if you are looking to solidify your understanding.

- Purcell, Edward M.; Morin, David J. (2013). *Electricity and Magnetism* (3rd ed.). Cambridge University Press.
- Griffiths, David J. (2023). *Introduction to Electrodynamics* (5th ed.). Cambridge University.
- *The Feynman Lectures on Physics Vol. II*. Richard Feynman. The New Millennium Edition of the Lectures is available for free at www.feynmanlectures.caltech.edu.