PHYS-GA-2005.001: ELECTROMAGNETISM
COURSE INFORMATION
SPRING 2022

Instructor: Daniel L. Stein

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Lectures: 726 Broadway - Rm. 940 - Tuesday and Thursday 5:00pm–6:15pm

Recitation: 726 Broadway - Rm. 940 - Friday 12:30pm–1:45pm

Course description: This one-semester course is designed to present a rigorous formulation of the concepts of classical electricity and magnetism at the graduate level. It aims to provide students with a background in the subject that is sufficient for them to understand current research and to prepare them for the workplace. Topics covered will include the basic elements of electrostatics, magnetostatics, electromagnetic waves, radiation, diffraction, and scattering. Current research topics, such as the search for magnetic monopoles and high-temperature superconductivity, may also be presented and discussed if time is available.

This course is designed primarily for graduate students in physics. Other graduate students who have a sufficient mathematical and physics background to meet the necessary prerequisites may also take this course. It is essential that students taking this course have as prerequisites undergraduate electricity and magnetism and a working knowledge of vector calculus.

The material we will take up in this course has applications in physics, chemistry, biology, environmental science, astronomy, and engineering. We want you to

leave the course not only with physical understanding and computational facility, but with the ability to use these notions in their natural scientific contexts, and with an appreciation of their mathematical beauty and power.

Textbook: Jackson, J.D. *Classical Electrodynamics*, 3rd Edition.

Grading: While problem sets will be assigned each week, they are optional. There will be two hour-and-a-quarter length exams during the semester (dates to be announced) and a final exam (date to be announced). The final grade will be computed with the following weights:

First Exam	30%
Second Exam	30%
Final Exam	40%

Brightspace: The chief means of communication for this course will be the course site on Brightspace, accessed through home.nyu.edu. Students are expected to check this for up-to-date assignments—including material separate from the text—and announcements.

Homework: Homework assignments appear under Assignments in Brightspace. They will not be turned in nor graded. However, it is strongly suggested that you attempt these problems, either singly or in groups, and see either of us if you have difficulties.

Syllabus: Below is the syllabus of topics and their associated reading assignments during the semester. We will aim for roughly one week per topic, but all are subject to change as the semester progresses.

- Week 1: Introduction to Electrostatics (Jackson, Introduction and Survey, 1.1-1.11)
- Week 2: Boundary Value Problems in Electrostatics I (Jackson, 2.1-2.11)
- Week 3: Boundary Value Problems in Electrostatics II (Jackson, 3.1-3.13)
- Week 4: Multipole Expansions, Dielectrics, Macroscopic Media (Jackson, 4.1-4.7)
- Week 5: Magnetostatics (Jackson, 5.1-5.12, 5.15-5.17)
- Week 6: Maxwell Equations, Conservation Laws (Jackson, 6.1-6.4, 6.7, 6.10)
- Week 7: Electromagnetic Waves (Jackson, 7.1-7.6, 7.8)
- Week 8: Wave Guides and Resonant Cavities (Jackson, 8.2-8.5, 8.7-8.8)
- Week 9: Radiating Systems (Jackson, 9.1-9.4, 9.6-9.10)
- Week 10: Scattering and Diffraction (Jackson, 10.1-10.5, 10.8, 10.11)
- Week 11: Special Relativity and Electromagnetism (Jackson, 11.1-11.6, 11.9-11.10)
- Week 12: Collisions and Energy Loss of Charged Particles Traveling through Matter (Jackson, 12.1-12.3, 12.10, 13.1-13.2)

- Week 13: Radiation by Accelerated Charges (Jackson, 13.4-13.5, 13.7, 14.1-14.3, 14.8)
- Week 14: Bremsstrahlung and Radiation Damping (Jackson, 15.1-15.2, 16.1-16.2)