Electrodynamics II

Physics 322

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Lecture and Office Hours
Lecture meets on M-W-F from 12:00–12:50 p.m. in Physics 123.

Office hours will be held on M, W, Th 3–4 p.m., Tu 1–2 p.m., Th 11:00–noon

Text: David J. Griffiths, "Introduction to Electrodynamics," Fourth edition, Cambridge University Press, 2017.

additional texts for reference:

Joel Franklin, "Classical Field Theory," Cambridge University Press, 2018.

John David Jackson, "Classical Electrodynamics," Third edition, John Wiley & Sons, 1999.

Wolfgang K. H. Panofsky and Melba Phillips, "Classical Electricity and Magnetism," Second edition (1962), Dover 2005.

Edward M. Purcell and David J. Morin, "Electricity and Magnetism," Third edition, Cambridge University Press, 2013.

Andrew Zangwill, "Modern Electrodynamics," Cambridge University Press, 2013.

Website: http://people.reed.edu/∼jfrankli/Courses/P322.S25/

Course Structure: Lecture notes, including reading assignments, will be posted on the course website. Homework will be available on the course website on Fridays by 5 p.m., due the next Friday by noon. The homework will consist of both "ordinary" problems to be turned in on the course gradescope site, and "presentation" problems. For the presentation problems, students will either write up "lecture notes" on the problem, or prepare a ~ 15 minute description of the problem and its solution to be presented in class on Fridays (in-class presentations will occur roughly once a month on Fridays). As a general rule, the presentation, whether written or in class, should include:

- A clear statement of the problem in your own words, and with your own emphasis. (20%)
- The problem's connection to work we have done in class. (20%)
- A clear and correct solution to the problem. (40%)
- Possible extensions or implications stemming from your solution. (20%)

Each student is expected to prepare two of these problems during the course of the semester, one written, one in person (although all students should think about and solve these problems as part of homework). Presentations will be assigned on Monday after students have had a chance to take a look at the problems for the week.

In addition to homework and presentations, there will be a take-home midterm examination given the week of Monday, March 3th (due on Friday, March 7th), an in-class midterm on April 7th, and an in-class final examination scheduled during finals week.

The weighting of these components is as follows:

Homework	20%
Presentation - written	15%
Presentation - in-class	15%
Midterm - take home	20%
Midterm - in-class	10%
Final examination	20%

Learning Goals

This is a course on the theory, structure, and predictions of electrodynamics. We will study vacuum solutions to Maxwell's equations generated by moving charges, the relationship between special relativity and E&M (the theory that motivated its discovery), the production of electromagnetic radiation, and the field theoretic structure of E&M. By the end of the course, students should be able to

1. Identify the "radiation" portion of an electromagnetic field, and provide a model for the charge configurations that produce it.
2. Understand the electromagnetic field as a unified entity that has associated energy, momentum and angular momentum.
3. Predict, qualitatively and quantitatively, the relativistic motion of charged particles in the fields produced by both stationary and moving charges.
4. Describe the relation between special relativity and the electromagnetic field, in particular, by understanding how electromagnetic entities (fields and potentials) respond to Lorentz boosts.

Topics:. Here is a list of the topics, including chapter numbers from Griffiths, that we will cover.

- E&M and special relativity (Chapter 12).
- Conservation of field energy and momentum (Chapter 8).
- Point sources and Green's functions (Chapter 10).
- Radiation (Chapter 11).
- Conservation of field momentum and angular momentum (Chapter 8).
- Scattering.
- Electromagnetic waves in materials (Chapter 9).
- Field Lagrangians and an action approach.
- Alternative theories of electricity and magnetism.