PHYS 334 **Electromagnetic Theory II** **Spring 2024**

Course Syllabus

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Textbook

- David Griffiths, Introduction to Electrodynamics, 4th Ed.

Office Hours

- Whenever I'm around. Check my schedule on Google calendar.

Course Web Page

- http://www.eg.bucknell.edu/∼bvollmay/phys334

Course Description

Classical electromagnetism is one of the core subjects in any education in physics. Even though the main structure of the theory has been codified in just a few equations for over 100 years, the field is still interesting, relevant, and the subject of ongoing research.

In PHYS 333 you focused on electrostatics and magnetostatics, cases which arise with the charge distribution and current distribution are independent of time and consequently the electric and magnetic fields are static as well. Maxwell developed the full, consistent theory of electrodynamics which allows us to consider time varying fields. This turned out to be a huge step both in theory and in applications. It taught us that light is an electromagnetic phenomenon, that classical atoms would be unstable because they radiate energy, and ultimately that our notions of space and time must be modified by special relativity.

This course is intended as a preparation for graduate school in physics or a comparable technical career, so we won't be shying away from details or derivations. The tools of vector calculus will be used extensively. As for topics, we will begin with Maxwell's equations and develop the implications of the theory, including conservation laws (chapter 8), electromagnetic waves (chapter 9), radiation theory (chapter 11) and special relativity (chapter 12). Along the way we will build the necessary tools, including the potential formulation of electromagnetism (chapter 10) and Green's functions.

Course Structure

The course material is drawn from the texts and the lectures. Assigned reading will be given on the board for the coming lecture, and should be done before the next lecture. Class time will be used to expand on the reading and to work through examples. This will be done via a combination of lectures and in-class exercises.

- **Homework** — A homework set will be assigned each week and will be due at the beginning of class on Wednesdays. You are encouraged to work together on the homework sets, though you must write up the problems yourself. Late homework will come with a deduction of 10% for each day late.
- **Journals** — You are required to submit a journal entry for each reading assignment for each class. These serve the purpose of encouraging you to do the reading and, more importantly, giving me a useful guide as to what we should spend lecture time on, i.e., letting me know what's already clear and what's confusing from the reading. Your journal entry should demonstrate that you've done the reading and can contain any or all of the following: a summary, parts you found confusing, parts you found clear, parts your particularly liked or disliked, or general comments about the course. These will be scored on a 2 point scale.
- **Exams** — There will be three in-class midterm exams. The dates for these is given in the Course Schedule below.

Grading

- Problem sets: 20%
- Journals: 10%
- 3 Midterm exams: 45% combined
- Final exam: 25%

Accessibility

Any student who may need an accommodation based on the impact of a disability should contact the Office of Accessibility Resources at 570-577-1188 or `OAR@bucknell.edu`. The office will help coordinate reasonable accommodations for those students with documented disabilities.

Course Schedule

Dates	Topics	Reading
Jan 17–22	EM I and Maxwell's equations	Ch 1–7
Jan 24–Jan 31	Conservation of charge, energy, and momentum	Ch 8
Feb 2–5	Waves intro	9.1–9.2
Wed, Feb 7	Catch up and review	
Fri, Feb 9	**Exam 1**	
Feb 12–21	EM waves in matter and boundaries	9.2 – 9.4
Feb 23–Mar 4	Potentials and fields	Ch 10
Wed, Mar 6	Catch up and review	
Fri, Mar 8	**Exam 2**	
Mar 18–Apr 1	Radiation	Ch 11
Apr 3–8	Special relativity intro	12.1 – 12.2
Wed, Apr 10	Catch up and review	
Fri, Apr 12	**Exam 3**	
Apr 15–April 26	Relativistic Electrodynamics	12.2 – 12.3
Mon, Apr 29	Catch up and review	
Mon, May 6	**Final Exam**	