PHYS 333
Electromagnetic Theory I
Fall 2006

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Course Web Page: http://www.eg.bucknell.edu/~bvollmay/Teaching/phys333

Text

- INTRODUCTION TO ELECTRODYNAMICS, David Griffiths

Additional Reading

- *Electricity and Magnetism*, Edward Purcell. This is a very well written book at a somewhat lower mathematical level than Griffiths.
- *div, grad, curl, and all that: an informal text on vector calculus*, H. M. Schey.
- Your vector calculus text.

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. Everyone in this course has had some exposure to electricity and magnetism, but this is a rich subject, and you can study it at deeper and deeper levels. If you continue on in physics, there is another course in electromagnetism at Bucknell, PHYS 334, and you would probably take two more courses on it in graduate school.

This is as much a course in applied vector calculus and partial differential equations as it is a course in electromagnetic theory. We will *not* be studying "useful" device-oriented electronics like some of you did last spring in PHYS 235. Rather, you will be learning about the properties of abstract (but very real!) vector fields that are described by Maxwell's equations. The unification of electricity and magnetization (and optics, for that matter) into a single theory which can be described in a few equations represents one of the pinnacles of achievement in theoretical physics. Much of the last century of research into fundamental physics has been an attempt to recreate the theoretical beauty of Maxwell's equations, seeking to unify the strong, electromagnetic, weak, and gravitational forces.

Course Structure

The course material is drawn from the text and the lectures. Assigned reading will be given on the board for the coming lecture. Lecture time will be used to expand on the reading and to work through examples. Homework sets will be assigned weekly and due typically on Wednesdays. You are encouraged to work together on the homework sets, though you must write up the problems yourself. There will be three midterm exams. I strongly encourage you to keep up with the material, since this is the best preparation for an exam.

Grading

- Weekly problem sets: 35%
- 3 Midterm exams: 15% each
- Final Exam: 20%

Approximate Schedule

Dates	Topics	Reading
Aug. 23–28	Vector Fields and Vector Calculus	1.1–1.3
Aug. 30–Sept. 4	Vector Calculus and Delta Functions	1.4–1.6
Sept. 6–11	Electrostatics: Coulomb's Law, Gauss's Law	2.1–2.2
Sept. 13-18	Electrostatics: Potential, Work, Energy	2.3–2.5
Wed, Sept. 20	Catchup and Review	
Fri, Sept. 22	**Exam I**	
Sept. 25–29	Electrostatics Math Techniques: Laplace's Equation, Method of Images	3.1–3.2
Oct. 2–4	Electrostatics Math Techniques: Separation of Variables, Multipole Expansion	3.3–3.4
Oct. 6–11	Electric Fields in Matter: Polarization	4.1–4.2
Oct. 13–18	Electric Fields in Matter: Displacement and Dielectrics	4.3–4.4
Fri, Oct. 20	Catchup and Review	
Mon, Oct. 23	**Exam II**	
Oct. 25–30	Magnetostatics: Lorentz Force, Biot-Savart Law	5.1–5.2
Nov. 1–3	Magnetostatics: Vector Potential	5.3–5.4
Nov. 6–8	Magnetic Fields in Matter: Magnetization	6.1–6.2
Nov. 10–13	Magnetic Fields in Matter: Auxiliary Field H, Permeability	6.3–6.4
Wed, Nov. 15	Catchup and Review	
Fri, Nov. 17	**Exam III**	
Nov. 20–Nov. 29	Electrodynamics: Faraday's Law, Ampere's Law	7.1–7.2
Dec. 1-Dec. 4	Electrodynamics: Maxwell's Equations	7.3
TBA	**Final Exam**	