PHYS 333
Electromagnetic Theory I
Fall 2014

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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.

Synopsis

Classical electromagnetic theory is one of the core subjects in any education in physics. Even though the main structure of the theory has been codified in a just a few equations for well over 100 years, the field is still interesting, incredibly useful, 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 electromagnetic theory at Bucknell, PHYS 334; if you go on to grad school you will probably take two more courses in E&M in there.)

This course is as much a course in applied vector calculus 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; you will be studying the properties of the abstract vector fields that are described by Maxwell's equations. The unification of electricity and magnetism into a single theory which can be described in just a few equations is an example of what physicists call a beautiful theory.

While you may have been introduced to some of these topics previously, we will be studying them at a deeper level. The work you do in this course will feature

- Applied vector calculus;
  Verbal descriptions $\leftrightarrow$ Mathematical relationships $\leftrightarrow$ Geometrical interpretation;

- Work with a computer algebra system (*Mathematica*);

- Relatively long multi-step problems;

- Collaborative work;

- Reading and note-taking (building your own "text").

Grading

Problem Sets: 20%
3 Mid-semester Exams: 16% each
Final Exam: 22%
Other (Reading Responses, Reading Quizzes, Quizzes, ??): 10%

Tentative Exam Dates

- Friday September 19

- Friday October 17

- Monday November 17

Approximate Schedule

Week of	Topic	Reading
Aug. 25	Vector Fields	Ch. 1
Sept. 1	Vector Calculus	Ch. 1
Sept. 8	Electrostatics: Coulomb's Law, Gauss's Law	2.1–2.2
Sept. 15	Electrostatics: Potential **Exam I: Friday 9/20**	2.3
Sept. 22	Electrostatics: Work & Energy	2.4–2.5
Sept. 29	Multipole Expansion	3.4
Oct. 6	Electric Fields in Matter: Polarization	4.1–4.2
Oct. 13	(Fall Break 10/13) Electric Fields in Matter: Displacement and Dielectrics **Exam II: Friday 10/18**	4.3–4.4
Oct. 20	Magnetostatics: Lorentz Force Law, Biot-Savart Law	5.1–5.2
Oct. 27	Magnetostatics: Vector Potential	5.3–5.4
Nov. 3	Electrodynamics: Faraday's Law, Ampere's Law	7.1–7.2
Nov. 10	Electrodynamics: Maxwell's "Fix" **Exam III: Monday 11/18**	7.3
Nov. 17	Electromagnetic Waves	9.1–9.2
Nov. 24	Magnetic Fields in Matter (No class 11/26 & 11/28)	6.1–6.2
Dec. 1	Electric Potential: Special Techniques	3.1–3.3
Dec. 8	Special Techniques	
?	**Final Exam**	

Bucknell Honor Code

As a student and citizen of the Bucknell University community:

1. I will not lie, cheat, or steal in my academic endeavors.

2. I will forthrightly oppose each and every instance of academic dishonesty.

3. I will let my conscience guide my decision to communicate directly with any person or persons I believe to have been dishonest in academic work.

4. I will let my conscience guide my decision on reporting breaches of academic integrity to the appropriate faculty or deans.

Homework Policy

Most of your learning in this course will come when you work through the problems. Most students find many challenges in Griffiths' problems, which is what makes them such a valuable learning experience. I encourage collaboration with your peers as you work on the problems and face these challenges, but the work you hand in must be your own articulation of the solutions. I also encourage you to take advantage of my office hours when you and your peers get stuck. Griffiths is a popular text used at many colleges and universities, so it is not surprising that solutions to the problems are readily available. Use of written solutions, no matter what the source, is not acceptable, and will be regarded as academic dishonesty.

Disability Accommodations

Any student who may need an accommodation based on the impact of a disability should contact me privately to discuss specific needs.

Learning Goals

Students taking PHYS 333 will learn how to solve quantitative problems in electromagnetic theory (electrostatics, magnetostatics, electrodynamics, and electromagnetic waves) using vector calculus at the level of the examples and problems Chapters 1–7 (and parts of 9) in the text *Introduction to Electrodynamics* by David Griffiths. Students completing the course will demonstrate the proficiency in concepts in one of the major areas of physics, and they will use critical thinking skills to formulate and solve quantitative problems, as called for in our department's learning objectives.