



Physics 342/Engineering 342  
Electricity and Magnetism  
Spring, 2010 at Hope College



Instructor: Steve Remillard

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Office Hours: T,R 1:00-1:50; F 9:30-10:20      Lab: VanderWerf 28  
Lecture: M,W,F 12:00 – 12:50, T 11:00-11:50

My Philosophy for this Course

Unlike the introductory course, General Physics II, which established the ideas of electricity and magnetism, this course has two objectives: (1) to help you to develop a theoretical grasp of E&M which then allows you to solve new problems unaided by examples; and (2) to introduce you to the use of E&M at the professional level. To achieve the first objective, we will work through the first half of the textbook, *Introduction to Electrodynamics*, by David J. Griffiths, which provides a rigorous development of electricity, magnetism and electromagnetism. The second half of the book applies these rigorously developed principles to several advanced concepts including waves and waveguides, radiation, and special relativity. In principle you will be prepared to work through the second half on your own. We will have enough time to complete Chapter 9 on waves and waveguides together. To achieve the second objective, we will use some electromagnetic simulation software which is used by engineering and physics professionals to make design decisions. We will use this software for the purpose of visualizing fields, understanding boundary conditions, and to make some of our own design decisions.

Text

*Introduction to Electrodynamics*, 3<sup>rd</sup> Edition, by David J. Griffiths (Prentice-Hall, 1999)  
ISBN 0-13-805326-X

Prerequisites

Phys 280 *Introduction to Mathematical Physics and Engineering*  
Math 232 *Multivariable Mathematics II*

Course Evaluation

Tests 1 and 2	40%	(20% each)
One cumulative final exam	30%	
Homework	20%	
Computer and other projects	10%	

Grading System

The following scale will be used for the cumulative course grade: 93-100%=A, 90-93%=A-, 87-90%=B+, 83-87%=B, 80-83%=B-, 77-80%=C+, 73-77%=C, 70-73%=C-, 67-70%=D+, 60-67%=D, Below 60%=F. (Answer to FAQ: 83.0000% is a B, NOT a B-)

The Course Web Site:

<http://www.hope.edu/academic/physics/faculty/remillard/PHYS342.html> or just go to my faculty web page found on the physics department web site and select “Teaching”. The homework assignments will be posted on this website, and there is a password protected page where you will find solution keys.

Homework – **Six very important things you need to know.**

- There will be one weekly problem set due in class, usually on Friday. To accommodate holidays and tests, some problem sets may be due on a different day than Friday. Consult the assignments page on the course web site.
- Computer Aided Analysis projects will be done using Maxwell SV available for free download from [www.ansoft.com](http://www.ansoft.com). Please download this software and work through the getting started electrostatics problem before January 26.
- The readings listed in the syllabus need to be finished prior to the indicated class date. This is the only way this course will work for you. Class time will build on the reading – not replace it. Pop quizzes, which will count as homework points, might be necessary to force this practice.
- You might need to spend some time outside of class using the facilities in the advanced lab.
- Unless specifically requested, solutions done with MAPLE or any other program will be returned ungraded. Evidence that a computer program was used, such as obvious skipped steps, might have the same outcome.
- Late policy: 10% per day beginning at 5:00 pm. Weekends included.

Tests & Exam

Two closed book tests will be given. The final exam, which will be cumulative, will be take-home. If you miss a test, you must make it up quickly. I expect to be informed prior to the test time of your situation, and the excuse needs to be a good one.

Disabilities

If you require accommodation for any kind of disability that falls within ADA guidelines please contact me during the first week of the semester. Several useful services are also available from Student Development (395-7800) and the Academic Support Center (395-7830).

Comments about email

Please use your *firstname.lastname@hope.edu* email to communicate with your Hope faculty. Check your email daily for announcements. You are responsible for any announcement sent out by me to the class. Also, I would like to encourage you to always use face-to-face communication to provide feedback to your professors rather than email, as email “venting” so often results in regrettable one-way miscommunications.

Withdrawing

The deadline for withdrawing from this course or converting to P/F is **March 18, 2008**.

Some Tempting Opportunities for Academic Dishonesty in this Course:

discussing a test with someone who hasn't taken it; using a homework website or a **solution manual** for assignments; using MAPLE to solve homework problems that you are supposed to solve; copying homework instead of collaborating; Copying off a neighbor during a test or a quiz. I wasn't born yesterday and it is very hard to get away with systematic cheating under my watch. The penalty for cheating on homework or a test can be as severe as an F in the course, and will certainly result in a report to the provost. Buying a solution manual is the same thing as paying someone else to do your homework. All work in Physics/Engineering 342 is subject to scrutiny for plagiarism. See <http://www.hope.edu/lib/plagiarism/index.html> for more details on Hope College's policy on plagiarism and how to avoid plagiarism. Please see the college handbook for the full college policy on unethical behavior.

Extra Credit Policy

Your grade in this course is determined by your performance on course requirements. You have enough work to do just to perform well on these course requirements. If that performance is not going well, adding more work won't help. Therefore, there is no extra credit in this course.

## Course Schedule

Date	Assigned Reading	Class Topic
1/12	1.1	Vector Algebra, Coulomb's Law
1/13	1.2, 2.1	The "Del" Operator, Coulombic Electric Fields
1/15	1.3-1.4	Special Topics in Integral Calculus
1/18	1.5, 2.2.1-2.2.2	Delta Functions, Gauss's Law
1/19	2.2.3-2.2.4	Gauss's Law
1/20	1.6, 2.3	Electric Potential; Electrostatic Boundary Conditions
1/22	2.4	Work and Energy
1/25	2.5	Conductors and Capacitance
1/26	Ansoft Start Guide #1	Computer Aided Computation of Capacitance
1/27	3.1	Laplace's Equation; Uniqueness Theorems
1/29	3.2	The Image Method
2/1		The Image Method
2/2	3.3.1	Separation of Variables – Cartesian Coordinates
2/3	3.3.2	Expansion in Spherical Harmonics
2/5	3.4.1 – 3.4.3	The Multipole Expansion
2/8	3.4.4	Electric Dipoles
2/9	4.1	Polarization
2/10	4.2	Polarization Field
2/12	4.3	The Electric Displacement Vector
2/15-16	<i>Winter Recess</i>	
2/17	4.4.1	Dielectrics
2/19	4.4.2-4.4.5	Electric Boundary Conditions; Electric Field Energy
2/22		Research paper presentations
<b>2/23</b>	<b>Chapters 2-4</b>	<b>Test 1</b>
2/24	5.1	The Lorentz Force
2/26	5.2	The Biot-Savart Law
3/1		The Biot-Savart Law
3/2	5.3	Ampere's Law
3/3	5.4.1	The Magnetic Vector Potential
3/5	5.4.2 – 5.4.3	Applications of the Magnetic Vector Potential
3/8	6.1	Material Magnetization
3/9	6.2	The Magnetic Field Inside Matter
3/10	6.3	The Magnetic Field, H; Magnetic Boundary Conditions
3/12	6.4	Magnetic Materials
3/15		Catch-up
3/16	7.1	Applications to Electric Circuits
3/17	7.2.1 – 7.2.2	Faraday's Law
3/19-26	<i>Spring Break</i>	
3/29	7.2.3 – 7.2.4	Inductance
3/30	7.3.1 – 7.3.4	Maxwell's Equations
3/31	7.3.5 – 7.3.6	Maxwell's Equations in Matter; Boundary Conditions
4/2	<i>Good Friday</i>	

This schedule is subject to modifications as needed.

## Course Schedule, continued

<b>Date</b>	<b>Assigned Reading</b>	<b>Class Topic</b>
4/5		Applications of Maxwell's Equations; Superconductors
4/6	8.1	The Continuity Equation; Poynting's Theorem
<b>4/7</b>	<b>Chapters 5-7</b>	<b>Test 2</b>
4/9	9.1.1 – 9.1.2	The Wave Equation
4/12	9.1.3 – 9.1.4	Reflection; Transmission; Polarization
4/13	9.2	Electromagnetic Waves in Vacuum
4/14	9.3	Electromagnetic Waves in Matter
4/16		Electromagnetic Waves in Matter
4/19	9.4.1 – 9.4.2	Interaction of Waves with Conductors
4/20	9.4.3	Dielectric Dispersion
4/21	9.5	Waveguides and Transmission Lines
4/23		Cavity Resonators
4/26	Advanced Lab	Cavity Resonators
4/27	11.1.1 – 11.1.2	Electric Dipole Radiation
4/28	11.1.3	Magnetic Dipole Radiation
4/30		Catch-up
	<b>Final Exam</b>	Take Home

This schedule is subject to modifications as needed.