Physics 350 Electrodynamics Fall 2017

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Class Mtgs: MWF 9:40-10:40 (TREX 272)
Office Hrs: MW 2-4, Thurs 1-2:30 Email:
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Course Description:

Developed examination of electrostatics, potential theory, dielectric media, magnetostatics, and an introduction to Maxwell's equations.

Textbook:

• *Introduction to Electrodynamics,* David Griffiths, 3rd edition (1999). ISBN-13 9788120316010

Purpose of the Course:

Electrodynamics is an introductory framework for understanding and appreciating the world of "field theory". Because the **E** and **B** fields are primary examples of a "vector field", they present themselves as the primary place of introduction to this branch of physics. The application of field theory spans all of physics, from the most tangible (fluid mechanics) to the most ethereal (string theory). Specifically, electrodynamics serves as the backbone for the following branches of physics: astrophysics, biophysics, cosmology, electrical engineering, the whole spectrum of materials science, and particle physics. Thus, a thorough understanding of electrodynamics will serve you well whatever your future endeavors in physical science. In doing so, we will try not to miss the beauty of the forest for the trees. The "trees" of partial differentiation, vector notation and non-Cartesian coordinates are towering oaks that will require our focused energy and though. However, having made this effort, you will emerge with a clear vision of one of the most ubiquitous "forests" – the electromagnetic field. I will work to draw attention to the main takeaways of the mathematical treatment without sidestepping the intriguing connection between the mathematics and physical reality.

Specific Goals of the Course:

1. Identify underlying electromagnetic phenomena related to foundational applications in the field.
2. Attach and manipulate units as a viable source of knowledge about the physical world.
3. Construct organized problem solutions that demonstrate logically connected sequences of thought.
4. Synthesize numerical information, physical assumptions, and previous concepts to correctly solve problems in electromagnetism.

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Feedback and Evaluation:

I will assign numerical grades to all your work. I *may* curve your final grades (upward), but otherwise you can expect to receive an "A" for 90-100, a "B" for 80-89, etc. I will assign +/- to your final grades by examining the distribution of grades. These are the categories and percentages that will be used:

Homework:	20%
Participation:	10 %
Mastery-Based Tests and Final	70 %

Homework problems are due **at the start of class** on the due date. You will learn the material best by working and persevering with challenging problems. I encourage you to discuss homework problems with other students, but you must not just borrow a problem solution from another student; you should write up the solution independently. I will grade one homework problem (chosen at random) each week and return it on Monday; the solutions to all homework problems from the previous week will be posted on Inquire on Monday.

Participation will include participation in several in-class activities, attendance, and general attentiveness. In addition, each student will be required to present one homework problem solution in class during the semester, and to attend and summarize two MCSP Colloquium Talks.

Tests and the final exam will follow the format of Mastery-Based Testing. I have compiled 16 essential topics (see next page) comprising the main content of this course; you mastery of problems on these topics will be assessed through four semester tests and the final exam. Each problem submitted is graded as either "mastered" or "not mastered"; a grade of "mastered" indicates that further work on that topic on tests/exams is not necessary. Once you have mastered a topic, you do not need to attempt it again or a future test/exam. There is no penalty for multiple attempts to achieve mastery of a topic. Your grade on tests/final exam is determined by the number of questions/topics you have mastered at the end of the semester, according to the following chart:

Topics Mastered	16	15	14	13	12	11	10	9
Percentage	70	67	64	61	58	55	52	49
Topics Mastered	8	7	6	5	4	3	2	1
Percentage	45	40	35	29	23	16	8	0

The idea behind Mastery-Based Testing is that it gives you multiple attempts to learn specific, well-defined topics in depth. In a traditional point-based system, a blank exam question can be a sizeable blow to your final grade. In the Mastery-Based system, a blank question can by fully made up on a later test. In addition, in a points-based system, a good strategy is to learn some basics about every topic, which often leads to students earning half to three-quarters credit on the test items, leading to a passing grade overall. It can be questioned whether this result really represents mastery of at least a good part of the course material. A student wishing

to earn a passing grade in the Mastery-Based system must fully understand an appreciable subset of the main ideas of the course, and a student wishing to earn an A grade must understand most or all of the main ideas in depth.

There are four test dates listed on the main part of the syllabus. On these dates, you have the opportunity to attain mastery in the topics listed below (again there is no need to attempt problems on topics you have previously mastered). The final exam date represents a final opportunity to attain mastery.

Test 1: Topics 1-6
Test 2: Topics 1-11
Test 3: Topics 1-15
Test 4: Topics 1-16
Final Exam: Topics 1-16

List of topics/problems to be mastered:

1. Vector algebra
2. Vector calculus and Green's Theorem
3. Vector calculus in other coordinate systems
4. Electrostatic distributions
5. Electric field and potential
6. Integrating charge distributions
7. Laplace's equation in 2-d
8. Dipole fields and torques
9. Polarization
10. Surface and volume bound charge
11. Electric displacement and linear dielectrics
12. Using the Biot-Savart Law
13. Magnetic Vector Potential
14. Magnetization
15. Surface and volume bound currents
16. Motional EMF

MCSP Colloquium Series:

The MCSP department offers a series of discussions that appeal to a broad range of interests related to these math, computer science and physics. Members of this class are invited to be involved with all of these meetings; however participation in **at least two** of these sessions is mandatory. Within **one week** of attending a colloquium you must submit (via a link on Inquire) a one-page single-spaced paper reflecting on the discussion. This should not simply be a regurgitation of the content, but rather a personal contemplation of the experience.

Attendance Policy:

Attendance is very important. You must notify me in advance if you must miss class for a valid reason (an excused absence). Any student who misses a total of five classes unexcused will be dropped from the course with a grade of DF. A warning email (cc'd to your advisor and the registar) will be sent after the fourth unexcused absence occurs. Note that if a student shows up for class 10 minutes late, walks out in the middle of class, or is caught napping/texting/checking emails/browsing the Internet during class, that student will be given an unexcused absence for the class.

Expected Hours of Work:

As a one credit course, this course expects you to spend at least 12 hours per week inside and outside of class.

Policy on Late Work:

I will grade an assignment with a 10% lateness deduction if turned in by 5:00PM on the due date. Following that, assignments will receive a further 10% lateness deduction for each successive school day late (with days considered to end at 5:00 PM). Assignments more than two weeks late will receive no credit.

Make-up Tests:

Make-up tests may be given only under unusual circumstances. If you miss a test, and have an official college excuse for that absence, then I may be willing to arrange for a make-up test.

Academic Integrity:

The College academic integrity policies are vigorously enforced. Although you are encouraged to work in groups on your homework assignments, all work turned in for a grade must be your own. Please familiarize yourself with the College's academic integrity policies.

Disability Support Services:

If you are on record with the College's Office of Disability Support Services as having academic or physical needs requiring accommodations, please meet with me during my regular office hours or schedule an appointment as soon as possible. We need to discuss your accommodations before they can be implemented. Also, please note that arrangements for extended time on exams and testing in a semi-private setting must be made at least one week ***before every exam***. If you believe you are eligible for accommodations but have not yet formally contacted Disability Support Services, please contact the Coordinator for Disability Support Services at 3752247 or drop by the Center for Learning & Teaching in Fintel Library.

#	Date	Topic	Reading	HW Problem(s)
1	Aug. 30	Intro; Brief review of E & M	--	
2	Sept. 1	Vector algebra roundup	Section 1.1	1.7
3	4	Differential vector calculus	1.2	1.11b, 1.15b, 1.18b
4	6	Integral vector calculus in 1D and 2D	1.3	1.29
5	8	Integral vector calculus in 3D	1.3	1.32
6	11	Curvilinear coordinates	1.4	1.39
7	13	Dirac δ, Vector field theory	1.5-1.6	
8	15	The electric field	2.1	2.3
9	18	Divergence of electrostatic fields	2.2	2.9
10	20	Curl of electrostatic fields	2.2	2.14
11	22	Electric potential	2.3	2.21
12	25	Work and Energy in Electrostatics	2.4	2.31
13	27	Conductors	2.5	2.35
14	29	Laplace's Equation	3.1-3.2	
15	Oct. 2	Test 1: Topics 1-6		
16	4	Separation of variables	3.2-3.3	
17	6	Multipole expansion and dipole moment	3.4	3.27
18	9	Polarization	4.1	3.31
19	11	Bound charges	4.2	4.2
20	13	Field of polarized objects	4.2	
		FALL BREAK		
21	23	Electric displacement	4.3	4.5
22	25	Electric displacement	4.3	4.10
23	27	Linear dielectrics	4.4	4.15
24	30	Dielectric materials	4.4	4.18

25	Nov. 1	Lorentz force law	5.1	4.26
26	3	Biot-Savart law	5.2	
27	6	Test 2: Topics 1-11		
28	8	Biot-Savart Law	5.2	5.3
29	10	Divergence and Curl of B	5.3	5.8
30	13	Magnetic Vector Potential	5.4	5.13
31	15	Magnetization	6.1	5.34
32	17	Field of magnetized objects	6.2	
33	20	Magnetized fields	6.2	
34	27	Ohm's Law and EMF	7.1	6.1
35	29	Motional EMF	7.1	
36	Dec. 1	Test 3: Topics 1-15		6.25, 7.2
37	4	Electromagnetic induction	7.2	
38	6	Maxwell's equations	7.3	
39	8	Test 4: Topics 1-16		
		FINAL: Wed, December 13, 8:30-11:30		