Physics 350 Electrodynamics Fall 2019

Instructor:	Daniel Robb	Class Mtgs:	T/Th 10:10-11:40 (TREX 272)
Office:	Massengill 243	Office Hrs:	by appointment
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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, 4th edition (2017). ISBN-13 978-1108420419

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. You will achieve this through a combination of self-study of the textbook and interactive group work during class.

Specific Goals of the Course:

1. Strengthen one's knowledge of vector calculus with intuitive physical applications
2. Identify underlying electromagnetic phenomena related to foundational applications in the field.
3. Actively construct one's understanding in class via small-group problem-solving, following pre-class recorded lectures.
4. Extend the material presented in an interesting direction via a substantial group project.

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:

Preparation:	10%
Participation:	25%
Problem Sets:	25%
Tests:	30%
Final Project:	10%

Preparation will consist of watching a pre-recorded lecture, and will be evaluated via a straightforward quiz given at the beginning of each class period. Preparation is important because it enables you to participate actively in the collective group problem-solving (see next item).

Participation will consist mainly of collective group problem-solving on several problems per class. I will be lecturing very little during class, and relying on your viewing of the pre-recorded lectures and your collective work on these problems to absorb the material. You will rotate through groups of two or three as the semester progresses, getting to work with all (or nearly all) other members in the class – valuable experience in learning to work with others with different problem-solving styles and personalities. You are not required to solve each problem in the time allotted, but to put in a strong effort, at which point the solution will be revealed and discussed. Note that MCSP write-ups (see below) also form a small portion of the participation grade (5 of the 25%).

Problem sets will be due on Tuesdays at the start of class, and should reflect your individual efforts, with collaboration only at the level of general concepts. They will be returned the following Tuesday, and solutions will be posted online.

The first two tests will involve problems similar in difficulty to those in the problem sets. These first two tests will also include several conceptual questions, in short-answer format. The third test (final exam) will involve general conceptual questions regarding all of the group projects presented during the last two weeks of the course.

The final project will consist of an oral presentation on an extension of the course material to a related and/or more advanced topic, in four groups of either four or five students. One week (two class days) will be devoted to researching the project, and the final week (two class days) to the oral presentations. Each group member should speak approximately an equal amount during the presentation. Again, the class is responsible for general conceptual understanding of the material presented within the final projects, at the level of clarity with which they are presented.

MCSP Colloquium Series:

The MCSP department offers a series of discussions related to math, computer science and physics. Members of this class are invited to attend 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 be not only a summary of the content, but also a personal reflection on the experience of the talk.

Attendance Policy:
Attendance is very important, especially given the interactive group nature of the in-class experience. 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 registrar) will be sent after the fourth unexcused absence occurs. If a student shows up for class 20 minutes late, walks out in the middle of class, or is caught repeatedly 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:
For problem sets, 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).

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 will generally be willing to arrange for a make-up test, but I reserve the right to have your overall test average substitute for the missed test.

Academic Integrity:
The College academic integrity policies are vigorously enforced. Although you are encouraged to work in groups on problem sets, at a general conceptual level, all specific problem-solving work turned in for a grade must be your own. Please familiarize yourself with the College's academic integrity policies.

Accessible Education Services:
Accessible Education Services (AES) is located in the Goode-Pasfield Center for Learning and Teaching in **Fintel Library**. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Laura Leonard, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Laura Leonard at your earliest convenience to schedule an appointment.

#	Date	Topic	Reading	HW Problem(s)

1	Aug. 29	Review of 202 and vector algebra	Section 1.1	
2	Sept. 3	Differential vector calculus	1.2	
3	5	Integral vector calculus	1.3	
4	10	Green's theorem; curvilinear coordinates	1.3,1.4	
5	12	The electric field	2.1	Problem Set 1
6	17	Div and curl of electrostatic fields	2.2	
7	19	Electric potential	2.3	
8	24	Work and Energy in Electrostatics	2.4	
9	26	Laplace's Equation, separation of vars	3.1,3.3	
10	Oct. 1	Multipole expansion and dipole moment	3.4	
11	3	Polarization	4.1	Problem Set 2
12	8	Lorentz force law	5.1	
13	10	**TEST 1**		
		FALL BREAK		
14	22	Biot-Savart law	5.2	
15	24	Divergence and Curl of B	5.3	
16	29	Magnetic Vector Potential	5.4	
17	31	Multipole expansion	5.4	
18	5	Paramagnetism and diamagnetism	6.1	Problem Set 3
19	7	Ohm's Law and Motional EMF	7.1	
20	12	Electromagnetic induction	7.2	
21	14	Maxwell's equations	7.3	Problem Set 4
22	19	**TEST 2**		
24	21	Group projects		
25	26	Group projects		
	28	**THANKSGIVING**		
26	Dec. 3	Group presentations		
27	5	Group presentations		
		FINAL: Thurs, December 12, 8:30-11:30		