Physics 350 Electromagnetic Theory Fall 2025

Instructor: Dr. Fatima Class Mtgs: M/W/F 8:30 AM-9:30 AM (TREX 273)
Office: Trexler 172A Email: fatima@roanoke.edu
Phone: 375-2057
Office Hrs: Tue 10:00 AM-12:00 PM and 1:00 PM -2:00PM; Wed 12:00 PM-1:00 PM (Trexler 172A/via zoom by appointment)

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:

This course introduces electrodynamics, the study of electric and magnetic fields. These ideas form the basis for many areas of physics and engineering, astronomy, biophysics, electrical engineering to materials science. We will focus on both the problem-solving tools and the bigger picture of how electromagnetic fields work. Learning will take place through the textbook, lectures, and group activities.

Learning Outcomes:

By the end of this course, students will be able to:

1. Strengthen their knowledge of vector calculus by applying it to physical situations.
2. Identify and explain key electromagnetic phenomena in foundational applications.
3. Construct their understanding of concepts through small-group problem-solving following lectures.
4. Extend course material in new directions by completing a substantial group project.

Feedback and Evaluation:

Class grades will be calculated according to the following distribution-

Participation:	20%	Tests:	30%
Problem Sets:	35%	Final Project:	15%

Furthermore, letter grades will be assigned at the end of the semester according to the following scale-

A-	90-92	A	93-100		
B-	80-82	B	83- 86	B+	87-89
C-	70-72	C	73- 76	C+	77-79
D-	60-62	D	63- 66	D+	67-69
F	<60				

Participation will consist mainly of attentive attendance (7 pts), in-class activities (8 pts) including collective group problem-solving on several problems per class, listening (and responding) to lectures, engagement in question and answer, working on in-class problems, and summaries of two MCSP

Colloquium Talks (5 pts). 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.

Problem sets are due **at the start of class** on the due date. Un-/assigned problems (like those in the problem sets) are "**when and where**" you will learn the course material. For better and for worse, there is no way to learn the depth of the material within the one-hour sessions that we will have together. Due to the nature of problem solving, I expect that you will work together *toward* a solution. However, I also expect that you will create an original solution to each assigned problem. Substitutions and simplifications should **NOT** be left to the "reader" (that's me) to figure out. If necessary, words and phrases need to be properly placed so that I can follow your train of thought.

All three tests will include conceptual questions (in short-answer format) and problems comparable in difficulty to those in the problem sets. The third test (final exam) will cover Chapters 2 and 3, as well as all group projects presented during the last two weeks of the course. From the group project presentations, only conceptual questions will be included.

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 groups of three students. Two class periods will be devoted to researching the project, and four class periods 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.

General Attendance Policy:
You are expected to attend every meeting. If you are going to be absent, I must be notified in advance. You are accountable for all work missed because of an absence. Your third and each additional absence will result in a 0.5-point reduction in your participation grade. You get two freebies so that I don't have to distinguish between excused and unexcused absences. College athletes will be afforded wiggle room; please come see me immediately if you are an athlete. If you should have an emergency

Expected Hours of Work
You are expected 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 5% lateness deduction if turned in by 5:00PM on the due date. Following that, assignments will receive a further 5% lateness deduction for each successive

school day late (with days considered to end at 5:00 PM). Once the solution has been posted in Inquire, no further assignment submissions will be accepted.

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.

Academic Integrity:

The College academic integrity policies (see www.roanoke.edu/academicintegrity) are 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 on the first floor of the Bank Building. 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 Dustin Persinger, Assistant Director of Academic Services for Accessible Education, at 540-375-2248 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 Dustin Persinger at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester. The testing center, also located on the first floor of the Bank Building, can be reached at 540-375-2247.

The following schedule outlines the tentative timeline for the covered topics and exam dates:

#	Date	Topic	Reading	HW Problem(s)
1	Aug. 29	Review of 202 and vector algebra	Section 1.1	
2	Sep. 3	Differential vector calculus	1.2	
3	5	Integral vector calculus	1.3	
4	10	Curvilinear coordinates	1.4	
5	12	Green's theorem	1.3	Problem Set 1
6	17	The electric field, its div and curl	2.1, 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	Problem Set 2
11	3	Polarization	4.1	
12	8	**TEST 1**		
13	10	Lorentz force law	5.1	
	13-17	**FALL BREAK**		
14	22	Biot-Savart law	5.2	
15	24	Divergence and Curl of B	5.3	
16	27	Magnetic Vector Potential	5.4	
17	29	Multipole expansion	5.4	
18	31	Paramagnetism and diamagnetism	6.1	Problem Set 3
19	Nov. 3	Ohm's Law and Motional EMF	7.1	

20	5	Electromagnetic induction	7.2	
21	7	Maxwell's equations	7.3	Problem Set 4
22	17	**TEST 2**		
23	19	Group projects		
24	21	Group projects		
25	24	Group presentations		
	26-28	**THANKSGIVING**		
26	Dec. 1	Group presentations		
27	3	Group presentations		
28	5	Group presentations **FINAL: Fri, December 12, 8:30-9:30 AM**		

Disclaimer: Everything above is subject to change with notice and, where appropriate, your approval.