Physics 202 Electricity and Magnetism Fall 2024

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Class Times: MWF 9:40-10:40 (Trexler 272)
Student Office Hrs: M 2-4, Th 2-4
(Make appts at calendly.com/daniel_robb)

Course Description:
Continuation of PHYS 201; electricity and magnetism, circuits, and some applications of classical physics.

Textbook:
• *Physics for Scientists and Engineers: Technology Update,* by Serway & Jewett, 9th ed, ISBN-13 978-1305116399
(You may use the 8th or 10th edition if you prefer, as the content and organization are very similar.)

Purpose of the Course:
You will learn about the nature of electricity and magnetism. These are two of the three fundamental forces through which everything in the universe interacts. (Well, everything bigger than an atomic nucleus, anyway!) These forces act within the framework of Newtonian mechanics, which you studied in PHYS 201. In addition, you will learn how electricity and magnetism concepts manifest themselves in the understanding of the behavior of electric circuits. The analytical and mathematical skills you gain in the process will make you a more effective problem-solver in your chosen field.

Specific Goals of the Course:
1. to understand the principles of electricity, magnetism, and basic DC and AC circuits.
2. to become familiar with several examples of modern technology based on these principles.
3. to further develop your analytical skills by solving quantitative problems in a structured way.

You will not need to memorize equations in this course. *In fact, you will be given all the equations you need on the tests*! You will learn to think carefully about the situation described in a problem, applying your knowledge of physics concepts to determine a strategy. The equations to use will follow naturally from a correct conceptual analysis of the problem.

Academic Integrity:
I will follow the college Academic Integrity policy, and you are responsible for knowing and following the college policy. Assigned homework problems may be discussed with others, but you should not take the entire solution process from another person, and you must formulate and write up solutions on your own. You may use generative AI tools as a last resort to generate ideas on homework problems. However, but aware that at this point these tools' solutions are not always fully correct. You must write up solutions on your own in any case. Note I am contractually obligated to report students if I suspect that they have engaged in academic dishonesty. Lastly, unless otherwise directed, cell phones should be silenced and out of sight during all class periods.

Policy on Late Work:
The course material is cumulative, so it's important for you to receive rapid feedback on your work. Thus, quiz solutions and graded quizzes will be available by the next class period after the quiz is taken. If you have an illness or excused absence which truly prevents you from taking a quiz, and notify me **beforehand**, I will generally exempt you from the quiz. Please see the laboratory syllabus for the policy on late labs.

Methods of Instruction:

The concepts of electricity and magnetism are interesting, but can be challenging. This course is designed to provide multiple passes through the material, with opportunities to improve understanding with each pass.

First pass:

You are expected to do relevant textbook readings ***before class***. You are not expected to understand everything in the reading, but you should make an effort and try to identify areas of confusion.

Second pass:

Research has shown that physics students learn better when class time is spent on interactive activities designed to improve conceptual understanding, rather than on direct lecturing. So I generally will not cover the entire reading during lecture. Instead, I will present the main concept(s), and we'll work several in-class conceptual questions, during which you will both think individually and discuss with your neighbors.

Third pass:

To really master physics, there's no substitute for applying physics concepts to new problems. This is often not easy, but grappling with new problems is where you will make the most actual gains in your understanding. A set of homework problems will be posted on Inquire on Wednesdays and Fridays, and a 5-10 minute in-class quiz -- consisting of one of these homework problems -- will be given on Mondays and Wednesdays. Quiz solutions will be available on Inquire by the following class period, and graded quizzes will be returned the following class period.

Further resources:

(1) You will ground your understanding in the laboratories; every effort has been made to schedule the laboratory experiments so that they reinforce the course material.

2) We will devote the last 15 minutes of class periods to Python programming projects on relevant course topics. No previous Python experience is assumed, and you will work together in pairs ('pair coding') with instructor help available. Programming can lead to deeper physical insight into the material.

(3) You are encouraged to use student office hours to discuss the material, especially if you are having trouble.

Attendance Policy:

Please note that if you are feeling ill, I ask that you inform me via email and not come to class, for your own health and out of consideration for other students in the class. Outside of illness, you are expected to attend every class. Attendance is checked at each class meeting, and you must be in class to participate in the in-class activities which form part of the class participation grade. If you are going to be absent from class for a valid (excused) reason, I must be notified in advance either in person or via email. Your fourth and each additional unexcused absence will result in a 2-point deduction in your final course grade. Furthermore, you are accountable for all work missed because of any absence. I will provide class materials for a missed class but will not re-teach a missed class during office hours.

Make-up Tests:

Make-up tests will not be given. If you miss a test, and have an official college excuse for that absence, then your final exam grade will count for the missed test. If your test absence is unexcused, you will receive a zero.

Feedback and Evaluation:

You should expect to receive a final grade of "A" for 93-100, an "A-" for 90-93, a "B+" for 87-90, a "B" for 83-87, etc. I may adjust final grades slightly based on the distribution of numerical grades and my perception of your effort in the course. These are the categories and percentages that will be used:

Tests:	30% (3 @ 10 % each)	Final Exam:	15%
Lab Grade:	20%	Programming Projects:	10%
HW-Based Quizzes:	20%	MCSP Conversation Series:	5%

Tests will be given during class on the dates indicated. *You will be given all needed equations on the test,* though the equations will not be labeled. The final exam has the same format as the tests and is comprehensive.

Lab grade: Please see the lab class syllabus for information on the lab grade.

HW-Based Quizzes are 5-10 minute quizzes given at the start of class on Mondays and Wednesdays. The quiz questions will be drawn from a set of assigned homework problems given out two class periods in advance. Note that while working on assigned homework problems, you may discuss general concept(s) with a classmate, but you may not discuss specifics of the solution process. You may use generative AI tools as a last resort to generate ideas on homework problems, but do be aware that these tool's solutions are not always fully correct. You must write up solutions on your own in any case. Emphasis in grading the HW-based quizzes will be on the visual and written steps in the solution process – partial credit may be received even if a final numerical answer is incorrect. Graded quizzes will be returned the following class period, and quiz solutions will be available on Inquire by the following class period.

Programming Projects will result in Jupyter Python notebooks (.ipynb files) uploaded to Inquire. These will be evaluated for (i) effort/completeness and (ii) correctness/effectiveness on the given physics problem.

MSCP Conversation Series reports are completed by attending one talk in the MSCP Conversation Series (see https://www.roanoke.edu/inside/math_cs_and_physics/conversation_series/fall_2024), and submitting a paper, which should contain: (i) a brief summary of key ideas of the talk; (ii) a description of parts of the talk that were interesting or confusing; (iii) your justified critique, including the level of presentation and the content. **The paper is due (by upload onto our course Inquire site) no later than a week after the talk**. It should be word-processed, single-spaced, approximately one page, and use proper grammar. You may not use generative AI in writing your MCSP Conversation Series Report.

Use of Electronic Devices:

In class, you may use personal laptops/tablets, but only for course-related purposes. All other electronic devices must be turned off. On tests, you may use a scientific calculator; all other electronic devices must be turned off and out of sight. Violation of this policy on tests will be treated as a violation of the Academic Integrity policy.

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 Dustin Persinger, 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 Dustin Persinger at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4-9 PM, Sunday-Thursday. Subject Tutors are highly trained, current students who offer free, one-on-one (and small group) tutorials in over 80 courses taught at Roanoke College, including: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, and Social Sciences. Check out all available subjects and schedule 30- or 60-minute appointments at www.roanoke.edu/tutoring. If you have a question, feel free to stop by, or contact us at subject_tutoring@roanoke.edu or 540-375-2590. See you soon!

Course schedule

#	Date	Topic	Reading	Computation	Labs
1	Aug. 28	Intro; Simple harmonic motion	15.1,15.2	Using Python in Physics	No Lab
2	30	Energy of SHO, Pendulum	15.3,15.4,15.5	"	
3*	Sept. 2	Traveling wave, properties	16.1,16.2,16.3	"	
4*	4	Damped/forced osc's, wave	15.6,15.7,16.6	"	1: Standing Waves in Strings
5	6	Sound waves, Doppler effect	17.1 – 17.4	"	
6*	9	Interference, standing waves	18.1,18.2,18.3	"	
7*	11	Resonance and air columns	18.4,18.5,18.6	Hanging Harmonic Osc.	2: Air Column Resonance
8	13	Beat patterns, non-sinusoidal waves	18.7,18.8	"	
9*	16	E Charge, Coulomb's Law	23.1,23.2,23.3	"	
10*	18	Continuous charge distribution	23.5	"	3: Electric Field Mapping
11	20	E field and E field lines	23.6,23.7	"	
12*	23	E flux	24.1	"	
13*	25	Gauss's Law & Applications	24.2,24.3	E Field of Charged Rod	Exam 1 Review
14	27	**TEST 1**		None	
15	30	Electric potential	25.1,25.2,25.3	E Field of Charged Rod	
16*	Oct. 2	E Field from potential,	25.4	"	4: RC Time Constant
17	4	Potential of continuous distributions	25.5	"	
18*	7	Capacitance	26.1,26.2	"	
19*	9	Capacitor network rules	26.3,26.4	"	5: Electric Circuits
20	11	Dielectrics	26.5,26.6,26.7	"	
	12-20	**FALL BREAK**		None	
21	21	Electric current & resistance	27.1,27.2	E Field of Charged Ring	
22*	23	Temp effects, superconductivity	27.4,27.5	"	6: Magnetic fields
23	25	EMF, Effective resistance	28.1,28.2	"	
24*	28	Kirchoff Laws, RC Circuits	28.3,28.4	"	
25*	30	Magnetic field, force	29.1	"	Exam 2 Review
26	Nov. 1	**TEST 2**		None	
27	4	Motion of charged particle in B field	29.2,29.3	Motion of particle in B	
28*	6	B force on current-carrying wire	29.4	"	7: B Field of Current Loop
29	8	B torque and applications	29.5,29.6	"	
30	11	No class		None	
31*	13	Biot-Savart Law, Ampere's Law	30.1,30.2,30.3	"	8: EM Induction
32	15	Gauss's Law of Magnetism	30.4,30.5,30.6	"	
33*	18	Faraday's Law	31.1	Finding B using Biot-Savart	
34*	20	Motional EMF, Lenz's Law	31.2,31.3	"	
35	22	Generators and Motors	31.5	"	Exam 3 Review
36*	25	Self-induction, LR circuits	32.1,32.2	"	
	27-Dec 1	**THANKSGIVING BREAK**		None	
37*	2	Energy in B field, LC circuits	32.3,32.4,32.5	"	Make up lab
38	4	**TEST 3**		None	
39*	6	Review & Catchup		Finding B using Biot-Savart	
		FINAL: Wed, Dec 13, 8:30-11:30am			

Note: Including lab, you should expect to spend a combined total of about 18 hours per week on this course.
Note: Class numbers marked with an asterisk will begin with a 5-10-minute HW-based quiz.