

Physics 152
Accelerated Physics II: Electricity, Magnetism, and Optics
Lafayette College, Fall 2021



Professor

Professor: Zoe Boekelheide

Campus office: Hugel Science Center 026

Office hours: Mondays and Wednesdays 2:10-4pm - and always available by appointment - email me!

email: boekelhz@lafayette.edu

Class meeting times

Class meeting time: MWF 10-10:50am in Hugel 142

Lab: Tuesday 1:10-4pm (room TBD)

About this course

This course will cover electricity and magnetism at the sophomore undergraduate level. The physics of electricity and magnetism is explained extremely well by current theory (unlike some other fields of physics). Almost all electromagnetic phenomena can be described using Maxwell's equations plus the Lorentz force law.

Although the fundamental physics of electromagnetism is well-understood, that does not make it trivial or uninteresting! Electromagnetism is one of the most relevant fields of physics to our daily

lives. Almost all forces you encounter on a daily basis, besides gravity, are electromagnetic in nature. Friction and the normal force are some examples. Chemical bonds and biological processes also rely on electromagnetic interactions. The very powerful devices you use on a daily basis, such as smartphones, computers, and hard drives, rely on an understanding of electromagnetism inside materials. The study of electromagnetic properties of materials is a huge area of research in physics and related fields (including my own research on magnetic materials).

The course catalog says Physics 152 is: “An accelerated calculus-based introduction to the study of physics for science and engineering majors; a foundation on which an understanding of physics, physical chemistry, or engineering can be built. Topics include electrostatics, electric currents, magnetostatics, induction, electromagnetic waves, ray optics, interference and diffraction. A course satisfying degree requirements in all B.S. or A.B. degree programs. Not open to students with credit for Physics 133.”

Prerequisites

Calculus-based mechanics (Physics 131 or Physics 151 or equivalent) is a prerequisite for this course. Math 263 should be taken concurrently if you have not taken it already.

Communication with Prof. Boekelheide

In person: Office hours are set times when I make sure I am available in my office to meet with students on a drop-in basis. You may stop by any time during these hours and talk with me or ask a question. I expect to see every student in my office hours at some point during the semester! You can try stopping by my office at times outside my office hours, but I may not be available to meet with you. You can also e-mail me to set up another meeting time if my office hours don't work for you.

By e-mail: I check e-mail regularly. If you e-mail me, you should expect to hear back from me within 24 hours Mon-Fri (barring travel or other circumstances). Likewise, I will use e-mail to notify the class of reminders, weather cancellations, assignment clarifications, etc. You should check your e-mail every day, and if you suspect weather cancellations, to ensure you receive these communications.

Course Website

We will use moodle, <http://moodle.lafayette.edu>.

Course Materials

For this course, you will need the following textbook:

- **Textbook:** Sears and Zemansky's University Physics with Modern Physics, 14th ed., by Young and Freedman.

You DO NOT need the MasteringPhysics access code. The textbook is available from the Lafayette bookstore. It also should be on reserve at Skillman Library.

Learning Outcomes

After completing this course, you will be able to....

- Analyze the behavior of particles in response to electric and magnetic fields.
- Understand the connection between potentials, fields, and sources.
- Understand the interrelation of electric and magnetic fields through Maxwell's equations.
- Construct and analyze AC and DC circuits.
- Analyze optical systems with one or more lenses.
- Analyze the behavior of systems exhibiting interference.

In addition to the outcomes listed above, this course (particularly the lab component) will promote the following outcomes from the Natural Sciences section of the Common Course of Study:

- NS1. Employ the fundamental elements of the scientific method in the physical and natural world by identifying and evaluating a testable scientific hypothesis.
- NS2. Create and evaluate descriptions and representations of scientific data via equations, graphs, tables, and/or models.

Grades

Grades on various assignments serve multiple purposes:

- To provide feedback on your performance on given assessments (e.g. exams, reports). Ideally, your performance on such assessments reflects your understanding of the material, i.e. the degree to which you have met learning outcomes.
- To provide more immediate incentives for certain behaviors which are beneficial to your learning (e.g. studying or completing homework) or to the class as a whole (e.g. participating in class).

Here are some things that grades are completely irrelevant to:

- Your value as a human being.

Don't let grades take on more meaning than they deserve!

Your final course grade will be determined as follows:

Homework	20%
Lab overall	10%
Lab technical report	10%
Participation	5%
Exam #1	15%
Exam #2	15%
Final exam	25%

Detailed description of course components

Homeworks

Weekly homework assignments will be distributed in class and on Moodle. Homework will generally be due on Wednesdays at 11:59pm unless otherwise noted. Homeworks should be turned in to a bin in the hallway near my office door. Each problem will be equally weighted in your homework grade unless stated otherwise.

Doing the homeworks carefully and completely, checking your work, and redoing any problems that you missed, is the best way to learn the material and to study for the exams. And remember I said I expected to see you in my office hours? Make sure you give yourself enough time to ask questions about the homework before its due.

Labs

You will do 10 experiments over the course of the semester. Informal lab reports will be completed by pairs of lab partners during the lab period and submitted at the end of the period. You do not need to purchase a lab notebook for this course. You must pass the lab component of the course in order to pass the course as a whole.

Technical report

You will write a technical report about one of the lab experiments performed during the semester. Unlike the informal lab reports, the technical report is an individual project. The technical report should cover the experiment as described in the lab manual, and then go a little bit further. For example, you may choose to take additional data to clarify a conclusion, or perform additional data analysis beyond what is described in the lab manual.

Because your technical report will build upon a previous experiment, you should **SAVE YOUR DATA** for lab experiments during the semester. Save data in your network drive or by emailing it to yourself. Files saved on the lab computers are deleted when you log off.

The expected length of the technical report is about 5-15 pages (12 point font, double-spaced, including figures). Further information will be provided later in the semester.

Timeline for technical report submission:

Decide on topic	November 19
Draft due	December 3
Peer review due	December 6
Final draft due	December 10 (last day of classes)

Two lab meetings are reserved for you to work on technical reports. This would be the time to take additional data, if you let me know in advance what equipment you will need available. You may also use this time to discuss reports with other students or myself.

Class participation

You are expected to attend class, arrive on time, and participate in class discussions and group problem solving or other activities.

Exams

There will be two midterm exams and a final:

- *Exam #1* will be on Friday, October 1, in class.
- *Exam #2* will be on Friday, November 5, in class. This exam will assume knowledge of the material covered before Exam #1, but will primarily focus on material covered since then.
- The *Final Exam* will be a three hour exam during finals week at a time determined by the Registrar. The final exam is a cumulative exam, with slightly more emphasis placed on material that was not covered on either of the previous exams.

Intellectual honesty

From the Lafayette Student Handbook:

To maintain the scholarly standards of the College and, equally important, the personal ethical standards of our students, it is essential that written assignments be a student's own work, just as is expected in examinations and class participation. A student who commits academic dishonesty is subject to a range of penalties, including suspension or expulsion. Finally, the underlying principle is one of intellectual honesty. If a person is to have self-respect and the respect of others, all work must be his/her own.

You are expected to abide by the principles of intellectual honesty outlined in the Lafayette Student Handbook (available from <http://studentlife.lafayette.edu>).

Learning is a collaborative process. Discussion and collaboration with classmates on homework in this course is strongly encouraged. Googling the answers to homework problems is not (this violates the intellectual honesty policy). The work you turn in must be your own. You must understand and individually write out your answer to each problem. If you worked with classmates, acknowledge them on your homework paper.

Exams must be done on your own, using only materials specifically allowed.

Inclusion statement

In Physics 152, all students are welcome. Students and professors bring diverse identities to class, and it is my intention that all students feel included in the intellectual community of the classroom. Unfortunately, the history of science is full of exclusion, so it's important to be explicit about inclusion.

Please contact me if you feel your identity is not being honored in class, if you have a preferred name or pronouns that I am not aware of, you observe religious holidays which conflict with coursework, or if there is something else that I can or need to address. I am still learning, too, and your feedback is important to me.

Accommodation

It is important to me that nothing impedes your ability to do well in this course. If you have any disabilities which you feel may interfere with your ability to succeed in this class, please contact me to discuss ways of accommodating them.

Mandatory statement for any Lafayette course with a disability policy. In compliance with Lafayette College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Requests for academic accommodations need to be made during the first two weeks of the semester, except for unusual circumstances, so arrangements can be made. Students must register with the Office of the Dean of the College for disability verification and for determination of reasonable academic accommodations.

Mandatory Moodle privacy statement

Moodle contains student information that is protected by the Family Educational Right to Privacy Act (FERPA). Disclosure to unauthorized parties violates federal privacy laws. Courses using Moodle will make student information visible to other students in this class. Please remember that this information is protected by these federal privacy laws and must not be shared with anyone outside the class. Questions can be referred to the Registrar's Office.

Mandatory credit hour statement

The student work in this course is in full compliance with the federal definition of a four credit hour course. **The federal course credit rule requires a total of 180 hours (12 hours/week) of student work over an approximately 15-week semester for a full unit (four credit hour) course.** See the Registrar's Office web site for the full policy and practice statement (<http://registrar.lafayette.edu/additional-resources/cep-course-proposal/>).

Schedule for Lafayette Fall 2021 PHYS152 course
Prof. Zoe Boekelheide

Lec	Week	Date	Topic	HW due	Lab (Tues 1:10pm)
1	1	30-Aug	Charges and electric force		
2		1-Sep	Electric field; Superposition		Introductory meeting
3		3-Sep	Electric field lines	HW 1	
4	2	6-Sep	Dipoles		
5		8-Sep	Electric flux; Gauss's Law	HW 2	Electric fields
6		10-Sep	Gauss's Law		
7	3	13-Sep	Gauss's Law; Conductors		Gauss's Law
8		15-Sep	Conductors	HW 3	
9		17-Sep	Electric potential energy, electric potential		
10	4	20-Sep	Gradient; equipotential lines		Electric Potential mapping
11		22-Sep	Equipotential lines; resistivity	HW 4	
12		24-Sep	DC circuits; power		
13	5	27-Sep	DC circuits		DC circuits; I-V curves
14		29-Sep	Review electrostatics	HW 5	
15		1-Oct	Exam 1		
16	6	4-Oct	DC circuits; capacitance		Transients in RC circuits
17		6-Oct	Capacitance	HW 6	
18		8-Oct	RC circuits		
	7	11-Oct	Fall break		No lab - Fall break
19		13-Oct	Energy stored in electric fields		
20		15-Oct	Dielectric materials		
21	8	18-Oct	Begin magnetism		e/m lab
22		20-Oct	Magnetic force; magnetic dipoles	HW 7	
23		22-Oct	Biot-Savart law		
24	9	25-Oct	Biot-Savart law cont; begin Ampere's Law		current balance
25		27-Oct	Ampere's Law	HW 8	
26		29-Oct	In-class problems: Finding the magnetic field		
27	10	1-Nov	Begin electrodynamics		Faraday's law
28		3-Nov	Faraday's law examples and applications	HW 9	
29		5-Nov	Exam 2		
30	11	8-Nov	Faraday's law, mutual inductance		Work on technical reports
31		10-Nov	Self-inductance; LR circuit	HW 10	
32		12-Nov	LC circuit		
33	12	15-Nov	RLC circuits; Maxwell's correction to Ampere's Law		RLC (AC) circuits
34		17-Nov	Time-dept terms in Maxwell's eqns	HW 11	
35		19-Nov	Maxwell's equations; EM waves		
36	13	22-Nov	EM waves; Poynting vector		Work on technical reports
		24-Nov	Thanksgiving break		
		26-Nov	Thanksgiving break		
37	14	29-Nov	Double-slit interference		Interference and diffraction
38		1-Dec	Single-slit diffraction; standing waves	HW 12	
39		3-Dec	Index of refraction; law of refraction		
40	15	6-Dec	Total internal reflection		Tech report meetings
41		8-Dec	Thin film interference	HW 13	
42		10-Dec	Review		

Finals wk **Final exam (schedule TBD by registrar)** HW 14

Final exam is cumulative, but with somewhat more focus on topics that did not appear on midterm exams.