Physics 152
Accelerated Physics II: Electricity, Magnetism, and Optics
Lafayette College, Fall 2019

Professor

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Office hours: MW 2-4pm

Class meeting times

Lecture/discussion: MWF 10-10:50am in HSC 142

Lab: Tuesday 1:10-4pm in HSC 119

About this course

This one-semester course will cover electricity and magnetism at the sophomore undergraduate level. The physics of electricity and magnetism seems to be 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`. When I send email to the class, I typically use moodle, so make sure to check the e-mail address associated with moodle.

Course materials

For this course, you will need the following textbook:

- **Textbook:** Sears and Zemanskys 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.
- **Physics 152 lab manual:** Available at the bookstore.

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).

There are plenty of things that grades have zero relationship with such as:

- Your value as a human being.

Grades matter, but don't let them mean more than they do.

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 it's 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 should purchase a Physics 152 lab manual at the bookstore. For this course, lab reports will be submitted on loose paper; you do not need a lab notebook. 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 15
Draft due	November 27 (Weds before Thanksgiving)
Peer review due	December 4
Final draft due	December 6 (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 exams and a final:

- *Exam #1* will be on Friday, September 27, in class.
- *Exam #2* will be on Friday, November 1, in class. This exam will assume knowledge of 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.

Exam questions will resemble problems worked on homework and discussed in class. The exams will be closed book with an equation sheet provided.

Intellectual honesty

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 on homework in this course is strongly encouraged. However, the work you turn in must be your own. You must understand and individually write out your answer to each problem. Acknowledge your collaborators on your homework paper.

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

In your technical report, you must cite any sources you make reference to.

Accommodation

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 2019 PHYS152 course
Prof. Zoe Boekelheide

Lec	Week	Date	Topic	HW due	Lab (Tues 1:10pm)
1	1	26-Aug	Charges and electric force		
2		28-Aug	Electric field; Superposition		Introductory meeting
3		30-Aug	Electric field lines	HW 1	
4	2	2-Sep	Dipoles		
5		4-Sep	Electric flux; Gauss's Law	HW 2	Electric fields
6		6-Sep	Gauss's Law		
7	3	9-Sep	Gauss's Law; Conductors		
8		11-Sep	Conductors	HW 3	Gauss's Law
9		13-Sep	Electric potential energy, electric potential		
10	4	16-Sep	Gradient; equipotential lines		
11		18-Sep	Equipotential lines; resistivity	HW 4	Electric Potential mapping
12		20-Sep	DC circuits; power		
13	5	23-Sep	DC circuits		
14		25-Sep	Review electrostatics	HW 5	DC circuits; I-V curves
15		27-Sep	**Exam 1**		
16	6	30-Sep	DC circuits; capacitance		
17		2-Oct	Capacitance	HW 6	Transients in RC circuits
18		4-Oct	RC circuits		
19	7	7-Oct	Energy stored in electric fields		
20		9-Oct	Dielectric materials		e/m lab
21		11-Oct	Begin magnetism		
22	8	14-Oct	**Fall break**		
23		16-Oct	Magnetic force; magnetic dipoles	HW 7	No lab - fall break
24		18-Oct	Biot-Savart law		
25	9	21-Oct	Biot-Savart law cont; begin Ampere's Law		
26		23-Oct	Ampere's Law	HW 8	current balance
27		25-Oct	In-class problems: Finding the magnetic field		
28	10	28-Oct	Begin electrodynamics		
29		30-Oct	Faraday's law examples and applications	HW 9	Faraday's law
30		1-Nov	**Exam 2**		
31	11	4-Nov	Faraday's law, mutual inductance		
32		6-Nov	Self-inductance; LR circuit	HW 10	Work on technical reports
33		8-Nov	LC circuit		
34	12	11-Nov	RLC circuits; Maxwell's correction to Ampere's Law		
35		13-Nov	Time-dept terms in Maxwell's eqns		RLC (AC) circuits
36		15-Nov	Maxwell's equations; EM waves	HW 11	
37	13	18-Nov	EM waves; Poynting vector		
		20-Nov	Double-slit interference		Interference and diffraction
		22-Nov	Single-slit diffraction; standing waves		
38	14	25-Nov	Index of refraction; law of refraction		
39		27-Nov	**Thanksgiving break**	HW 12	Work on technical reports
40		29-Nov	**Thanksgiving break**		
41	15	2-Dec	Total internal reflection		
42		4-Dec	Thin film interference		Tech report meetings
43		6-Dec	Review	HW 13	Tech reports due
	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.