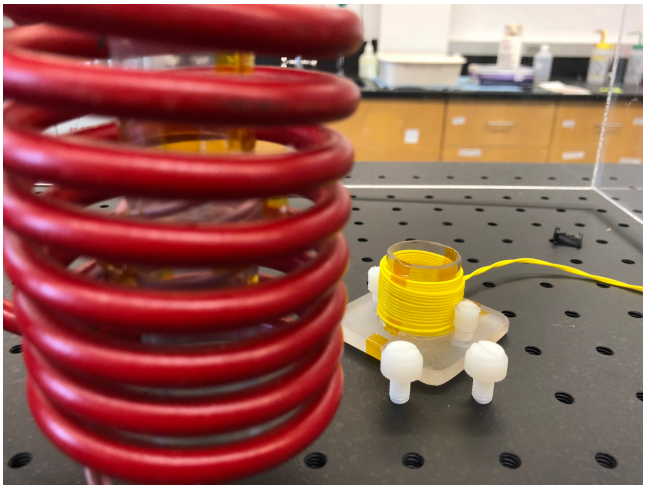
Physics 152
Accelerated Physics II: Electricity, Magnetism, and Optics
Lafayette College, Fall 2020



Professor

Professor: Dr. Zoe Boekelheide

Campus office: Hugel Science Center 026

Office hours: Formal office hours TBD, always available by appointment - email me!

email: boekelhz@lafayette.edu

Class meeting times

Class meeting time: MWF 10-10:50am

Lab meetings are set up by appointment on Tuesdays between 1:10-4pm

Zoom meeting ID: 934 1185 2836
Passcode: maxwell

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 (hence our Zoom password) 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`.

Considerations for remote learning

Zoom

- Please use your full preferred name to identify yourself on Zoom, as it will be helpful as we learn each others' names. Including your last name will help me connect your name and face with your place on my roster, and help other students find your email address in case they need to communicate about class issues.
- Please keep your video on if you can. Occasionally, students might reasonably need to turn video off (e.g. connection issues, roommate/family privacy issues, etc). In this case, please upload a Zoom profile picture so fellow students can remember what you look like!
- Please use headphones to minimize echo.
- Use of microphone mute: If you are not expecting to speak for a while (e.g. during a lecture, watching a video, or listening to a presentation), you should mute yourself to avoid any auditory distractions. However, during class discussions, you may want to keep your microphone on to minimize lag time in discussion (as long as you do not have significant background noise). In small groups/breakout rooms, you generally want to keep your microphone on.
- Recording of class sessions by students is prohibited. I will not typically record class sessions as they will primarily be interactive discussions, not lectures. If I do plan to record a session, I will notify you (this is required by Pennsylvania law).
- We aren't as new to this as we were in March, but we are all still learning. If new Zoom rules become necessary, we can discuss them and make changes as needed. If you have a suggestion for how to improve our Zoom experience, please let me know!

Required and recommended equipment

This course requires:

- a laptop/computer with webcam
- access to internet
- headphones with mic
- a mostly-quiet place to work/attend class
- paper and pencil for homework, and a way to scan to pdf (most smartphones can do this with an app)

You are expected to provide the above items yourself; however, students who do not have the required materials may be able to get help such as loaner laptops through Information Technology Services. If an unanticipated technology emergency arises, please let me know and I will try to connect you to the appropriate resources.

Although there are relatively few required items, there are some optional items that may make your work easier. Below are some recommended optional things which could improve your experience:

- Please use some kind of calendar or planner to keep track of due dates, meetings, etc. I use Google Calendar and I recommend it, but you can use whichever system works best for you. This one is only optional in the sense that I'm not going to ask you to prove you use a calendar - but it's really highly recommended!
- Neck strain from looking down at a laptop: The top of your screen should be at eye level for optimal ergonomics. Consider lifting your laptop by using a stack of books or a laptop stand, or utilizing an external monitor. If you lift your laptop, you may want an external keyboard for typing.
- It can be helpful to have a printer so you can have hard copies of, for example, homework problems. This allows you to work on homework in different locations (maybe even outside!) which could be helpful for your mental health.
- If you find other solutions to common work-from-home problems, please share them with your classmates and me!

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.

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.
- Analyze AC and DC circuits.
- 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. Don't let grades take on more meaning than they deserve!

Your final course grade will be determined as follows:

Participation	15%
Homework	15%
Labs	15%
Exam #1	15%
Exam #2	15%
Final exam	25%

Detailed description of course components

Participation

Because this is a remote class, many of the lectures will be prerecorded and you will watch them on your own before class. We will save class time for the more interactive components of the course - on a typical day we will address questions from the video lectures and any questions on the assigned homework. Some days, we will also have homework problem presentations or work on discussion questions or problems in groups.

Homeworks

Homework will generally be assigned weekly. We will dedicate one class session per week to student homework presentations (typically Wednesdays). You should come to this class session having made a solid effort on every homework problem - though you don't need to have figured everything out. If you are asked to present a problem, you should present as much as you can, and if you got stuck, explain why you are stuck. After homework presentations, you will have an opportunity to revise your homework and you will turn it in approximately two days later (typically Fridays). Most students will work with paper and pen/pencil - you can take photos of your work and turn them into pdf files fairly easily (e.g. through GeniusScan or another phone scanning app). You will turn in these pdfs through Gradescope (linked through Moodle).

Labs

I will assign lab partners at the beginning of the semester. Labs will be completed in pairs, mostly outside of class time. You will complete lab "experiments" by accessing a variety of video lab experiment resources (largely through Pivot Interactives, Princeton, or PhET). You will analyze data using LoggerPro, which you will need to install on your personal computers. You should write collaborative lab reports with your partner (Google Docs is probably the simplest way to do this). Lab assignments will be given to you at least a few days before our lab meeting time (Tuesday afternoon). During the lab meeting time, you and your lab partner will sign up for $\sim$ 20-minute meeting times with me and share your screen to show me your data and analysis. I will ask you follow-up questions to check your understanding. If you got stuck, I can help redirect you. You will turn in the final draft of the lab as a pdf through Gradescope.

Exams

All exams will be take-home exams and will have a different structure than traditional exams. I will ask you to prepare problems and solutions which address the main topics covered in class. You will choose problems that cover these topics and then present well-reasoned and complete solutions. Due to the take-home nature of the exam, showing your work and showing that you understand the physics will be of the utmost importance. The final exam may also have an oral component which would supplement the written component.

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 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.

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 2020 PHYS152 course

Prof. Zoe Boekelheide

***subject to change**

Class	Week	Date	Topic
1	1	17-Aug	Charges and electric force
2		19-Aug	Electric field; Superposition
3		21-Aug	Electric field lines
4	2	24-Aug	Dipoles
5		26-Aug	Electric flux; Gauss's Law
6		28-Aug	Gauss's Law
7	3	31-Aug	Gauss's Law; Conductors
8		2-Sep	Conductors
9		4-Sep	Electric potential energy, electric potential
10	4	7-Sep	Gradient; equipotential lines
11		9-Sep	Equipotential lines; resistivity
12		11-Sep	DC circuits; power
13	5	14-Sep	DC circuits
14		16-Sep	Review electrostatics
15		18-Sep	**Exam 1 due**
16	6	21-Sep	DC circuits; capacitance
17		23-Sep	Capacitance
18		25-Sep	RC circuits
19	7	28-Sep	Energy stored in electric fields
20		30-Sep	Dielectric materials
21		2-Oct	Begin magnetism
22	8	5-Oct	Magnetic force; magnetic dipoles
23		7-Oct	Biot-Savart law
24		9-Oct	Biot-Savart law cont; begin Ampere's Law
25	9	12-Oct	Ampere's Law
26		14-Oct	In-class problems: Finding the magnetic field
27		16-Oct	Begin electrodynamics
28	10	19-Oct	Faraday's law examples and applications
29		21-Oct	Faraday's law, mutual inductance
30		23-Oct	**Exam 2 due**
31	11	26-Oct	Self-inductance; LR circuit
32		28-Oct	LC circuit
33		30-Oct	RLC circuits; Maxwell's correction to Ampere's Law
34	12	2-Nov	Time-dept terms in Maxwell's eqns
35		4-Nov	Maxwell's equations; EM waves
36		6-Nov	EM waves; Poynting vector
37	13	9-Nov	Double-slit interference
38		11-Nov	Single-slit diffraction; standing waves
39		13-Nov	Index of refraction; law of refraction
38	14	16-Nov	Total internal reflection
39		18-Nov	Thin film interference
40		20-Nov	Review
		Finals wk	**Final exam**

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