Physics 133—Physics II: Electricity, Magnetism, and Waves
Section 1, MFW 11:40 am - 12:30 pm
Course Description, Fall 2026

Instructor:	Andrew Dougherty
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Course Web Page:	https://moodle.lafayette.edu/course/view.php?id=33293

Office Hours: You are not limited to times listed on my schedule. I will also normally be available on most other days during the free times indicated on my schedule. Please feel free to e-mail or call at any time and ask a question or set up an appointment. If you prefer to meet virtually, we will use the Zoom link on our Moodle page.

Classes on Snow Days and Other Emergencies: If I am unable to make it to class, I will send out a notice via email.

Web Pages: All course assignments and documents will be posted to our Moodle site.

Description: This course is a calculus-based introduction to the foundations of electricity, magnetism, and waves, intended for students majoring in science or engineering. Our emphasis will be on identifying, understanding, and applying the fundamental principles of electric fields and potentials, basic circuits, magnetic fields, and electromagnetic waves.

Prerequisites: Phys 131 or 151, Math 162 or permission of instructor.

Texts: You will need two items for the lecture portion of this course: the textbook and the online "Mastering Physics" component. The online platform includes the textbook, homework problems, and a very rich set of study aids, including pre-lecture videos and numerous fully-worked video tutor solutions. Any additional resources will be linked from our Moodle site.

Inclusive Access: This class will be participating in the First Day® inclusive access program. The materials for the lecture portion of this course will be available in digital format through Moodle. Charges for the accessible content are added to the cost of the course upon registration. To access your materials, use the "Course Materials" link on the Moodle course site.

You will have the option to opt out of using the First Day inclusive access materials should you wish to purchase the materials another way. The option to opt-out will be available until the last day of the add/drop period. To opt-out, select the large green [Opt Out] button when accessing the FirstDay inclusive access materials. If you opt-out, you will be credited after the add/drop period.

Purchasing on your own: If you opt out of the First Day program, here are the textbook details: The textbook is *University Physics with Modern Physics, 15th edition* by Hugh D. Young and Roger A Freedman. Both print and e-text versions are available. The on-line component is *Mastering Physics*. The textbook is the same one that has been used for the past several years at Lafayette in Phys 131/133/151/152, so used copies may be available. More details are available under Textbook Information on our Moodle site.

Lab Materials: You will also need the *Physics 133 Laboratory Manual Fall 2026*, available in the bookstore.

Calculator for Tests: You will need a scientific calculator for the tests—one that can do trig functions, but that does not connect to the internet. A phone app is *not* suitable.

Student Learning Outcomes: The main goal of this course is to help you understand, identify, and apply the fundamental principles of physics in a variety of situations. You should be able to use both qualitative reasoning and quantitative problem-solving skills in applying those principles. A second goal is to help introduce you to the *process* of doing physics, including skills such as developing and testing models, interpreting experimental data, solving problems, and communicating results.

Specifically, upon successful completion of this course, you should be able to

- Calculate the electric potential and field due to a variety of charge configurations,
- Calculate the magnetic field due to a variety of current configurations,
- Predict the motion of charges in a electric and magnetic fields,
- Build and analyze simple DC electrical circuits,
- Describe phenomena related to electromagnetic induction,
- Describe the characteristics of mechanical, sound, and electromagnetic waves, and
- Calculate the conditions for constructive or destructive interference of waves.

In addition to the outcomes listed above, this course (particularly the lab component) promotes the Common Course of Study outcomes from the Natural Sciences (Classes 2016–2028) or Study of the Natural World (with lab) (Classes 2029 and later):

- NS 1/NW 1 Employ the fundamental elements of the scientific method in the physical and natural world by identifying and evaluating a testable scientific hypothesis.
- NS 2/NW 2 Create and evaluate descriptions and representations of scientific data via equations, graphs, tables, and/or models.

Tests: There will be three hour-long in-class tests on the dates indicated on the syllabus. There may also be additional quizzes, either announced or unannounced.

Equation Sheet: You will receive an equation sheet with each test. A copy is available on our Moodle site. The idea is that you will use your study time to focus on the fundamental ideas and practice doing physics rather than to memorize formulae.

Final Exam: There will be a comprehensive final exam at a time to be arranged by the registrar. *Please do not make travel plans that conflict with the scheduled exam time.*

Laboratory: The laboratory is an essential part of this class, and successful completion of the laboratory is required in order to pass the course. You are responsible for completing all of the assigned experiments at the scheduled times. If you can not make it to your scheduled lab, please contact your lab instructor as soon as possible.

Grades: Your grade will be based on homework (20%), laboratory (20%), tests (40% total) and final exam (20%). The lowest test or final exam score will only count as half of the usual total. If the lowest score is one of the three tests, then that test will only count for 8% of the total, and the two remaining tests will each count for 16% of the total (for a total of 40% for the tests.) If the final exam is the lowest score, it will only count for 10%, and the test average will count for 50%. The lowest homework assignment will also be dropped. Feel free to ask questions about how your grade is determined.

Mentored Study Groups: This course participates in the Academic Hub's Mentored Study Group program. More details will be provided on our Moodle page.

Homework Problems: Homework assignments will be due *at the beginning of class* on the dates indicated on the syllabus. Some assignments will be given and graded using *Mastering Physics*, an on-line system with quick feedback, hints, and guided tutorials. Other assignments will be pencil-and-paper problems; these problems will typically focus as much on the *methods* of solving problems as on getting the right numerical answer.

- Problems will be due at the *beginning* of class.
- **Late homework will normally not be accepted** unless you have an absence covered by a Dean's Absence Verification or similar excuse.
- You get one free 1–class-day late homework pass. For one assignment, you may request a 1–class-day extension without explanation or penalty. If you need to submit any MasteringPhysics work after the deadline, you will have to contact me so that I can give you the extension.
- The lowest homework grade will be dropped.

- For written homework, I expect your work to be clearly organized and easy to follow. You should include not just numbers and calculations, but also include some text to explain *what* you are doing and *why*. This can often be quite brief, but it is *your* responsibility to make your reasoning clear; it is not the reader's responsibility to try to figure out what you meant. Homework that is incomplete or difficult to understand will not get full credit.

  1. Be sure to include your name on each page.
  2. Each problem should be clearly labeled. A common convention is to number problems with chapter and problem number, so that something like "2.27" refers to Chapter 2, problem 27. (Note too that this is from the "Problems" section at the end of the chapter, not the not "Questions" section.)
  3. For most problems, you should include a figure with clear labels.
  4. Show your work clearly, and include all non-trivial steps. Use words to explain what you are doing and why. This can often be very brief, something like "Use Newton's second law," or "Use conservation of energy since all the forces involved are conservative."
  5. Allow plenty of space.
  6. Put a $\boxed{\text{box}}$ around your final solution, including correct units.

- **Illegible papers will not be accepted**. If I have difficulty reading or understanding your work, I may return it to you ungraded for re-submission. You may resubmit a legible version (along with the original) by the next class meeting, but that version must not have any new content—it must simply be a legible version of the original.
- Please look at the homework problems ahead of time and ask questions about them either in or out of class. I am happy to give whatever help you need, but it is important that you eventually learn to do these problems on your own—after all, that's what you will have to do on the tests.

Grading: The text rates problem difficulties with dots; One, two, and three-dot problems will typically be assigned 10, 20, and 30 points respectively. Your total score for each week will be the sum of the on-line and pen-and-paper scores divided by the total number of possible points. For your overall homework grade, each week's assignment will be weighted equally. The lowest week will be dropped.

Significant Figures: Interpretation of any physical measurement or prediction involves understanding the underlying uncertainties. Unfortunately, a proper handling of propagating uncertainties in calculations would get quite involved for this course. In the lab, you will spend a good deal of time and effort thinking about and accounting for uncertainties in your results. In the lecture portion of the class, however, we will adopt a simpler approach.

Most problems will require numerical answers. You should normally aim for at least 1% accuracy. Typically, this means keeping 4 or 5 digits in intermediate calculations (or just leaving the intermediate result in your calculator memory) and 3 digits in your final answer. MasteringPhysics will sometimes tell you to give your final answer to 2 digits. You may usually ignore that and give 3 digits. If you need to use an answer in a later part of a problem, you should definitely use the full-precision answer, not one rounded off to 2 digits. Again, your goal is to get the right answer to at least 1% accuracy. Excessive round-off can sometimes make a big difference.

Attendance: You are expected to complete all assigned work in a timely fashion, but I do not take daily attendance. I appreciate notice if you are unable to attend class, but a Dean's Absence Verification (or similar documentation) is only required if you miss a test, exam, or other graded assignment.

Your Responsibilities:

- **Read the text.** Your text is a critical resource for this class—it is a source of definitions, facts, ideas, explanations, derivations, and worked examples. I do not intend to spend class time simply repeating the text. Instead, class time will be used to *discuss* those ideas, answer your questions, observe demonstrations, do examples, and practice applying those ideas to various physical situations.

  Accordingly, you should read the text ahead of time. I have included a detailed daily syllabus so you know what the assigned readings for each day will be.

  The text also includes a large number of video resources, including pre-lecture videos and numerous fully-worked out problems. Some of these may be explicitly assigned throughout the course, but you are encouraged to review the offerings with each chapter and make good use of these resources. See the `Study Area` link at our Mastering Physics course site.

- **Ask questions.** If you are confused, it is important that you stop me and try to sort it out rather than falling behind. *Please* interrupt and stop the class whenever anything isn't clear. Remember that if you are confused, there are almost certainly others who are confused as well, and they would welcome your question.

- **Do all assigned work.** A good rule of thumb is that you should anticipate spending approximately two hours outside of class for each hour in class for a college course. This means you should anticipate spending an average of six hours per week outside of class for physics (not including the lab). Plan ahead. I am here to help. If you start on your homework ahead of time, I will be available to help you if you get stuck. Don't wait until the night before an assignment is due before starting it.

- **Participate in class.** Class time will be used to go beyond merely reading the text. Your active engagement during class can play an important part in helping you to master the material. Class time will also be used to announce changes to the syllabus. I will also post everything to our Moodle site. It is *your* responsibility to keep up.

Academic Honesty: The fabric of science, and indeed any intellectual endeavor, is built on the integrity of all involved. Accordingly, I take academic honesty very seriously. I expect that you will abide by the "Principles of Intellectual Honesty" appearing in the Lafayette College Student Handbook.

Working with others is often a helpful way to learn physics. For this course–and indeed for most advanced courses in any discipline—I believe such collaboration to be an essential element for success. I encourage you to collaborate with each other, but unless specifically directed otherwise, all work you turn in *as* your own should *be* your own. My expectation is that everyone will be open to both giving and receiving aid from their peers.

Some students also find it useful to consult other texts, friends, and even a variety of online sources. In all cases, though, the principles of academic honesty apply: All nontrivial collaborators and external sources must be acknowledged (apart from your textbook and instructor). You may seek help understanding a problem, but all work you turn in must be your own original work. Copying an answer from another source, such as CourseHero, Chegg, Bartleby, or a generative AI source, is a violation of the Academic Honesty Policy.

Although some students believe that looking up solutions as soon as they get stuck helps their learning because they get immediate feedback, I would argue that the negatives of this approach outweigh any benefits.[1] In particular, merely looking up a solution:

- Creates a false sense of security that won't be there during exams.
- Can replace other healthy learning behaviors, such as: reading through the text for missing concepts or similar examples; asking a friend; asking a professor; taking a break and coming back to the question later; having a "Eureka" moment when out for a walk. These are all healthy learning behaviors, and doing less of them is a negative.
- Often fails to lead to actual learning. It won't necessarily help you the next time you encounter a somewhat similar situation. Students who take the "easy" way out and get excessive or inappropriate help from others tend to get significantly lower grades on the tests. Learning to do problems by yourself is the best preparation for the tests.
- Can lead to a culture where it feels like everyone knows the answer all the time and being unsure of a solution feels abnormal. This is exactly backwards. Being unsure of a solution is normal.

Please read the department's Academic Honesty policy for the rules regarding collaboration. Feel free to ask if you have any questions about this policy.

Proper Usage of Course Materials: All course materials are proprietary and for class purposes only. This includes posted recordings of lectures, examples, tests, solutions, and other course items. Such materials should not be reposted. Online discussions should also remain private and not be shared outside of the course. You must request my permission prior to creating your own recordings of class materials, and any recordings are not to be shared or posted online even when permission is granted to record. If you have any questions about proper usage of course materials feel free to ask me.

Class Recordings: From time to time, it may be useful to record our classes for those unable to attend in person. I will make any such recordings available on a Google Drive shared with the class.

These recordings are for the use of this class only, and should not be shared outside of the class. If you have any concerns with being recorded during the course please let me

[1] This discussion is based on one in Prof. Boekelheide's syllabus.

know.

Appropriate Use of AI Tools: You may use Generative AI tools in this course, provided you do so while still respecting intellectual honesty and privacy.

- **Intellectual honesty:** An AI tool can be helpful in solving physics problems, but your goal should be to learn how to solve problems by yourself. Unless specifically directed otherwise, all work you turn in *as* your own should *be* your own. All collaborators, including any AI sources, must be acknowledged, as discussed in the **Academic Honesty** section above.
- **Data privacy:** You should not upload any content that belongs to someone else into any AI model that might use that data as training data. For example, any textbook and class materials are for your use in this class; you do not have permission to give that content to an AI model unless that model explicitly does not use your data as training data. AI tools integrated into MasteringPhysics do have permission to use MasteringPhysics and textbook content.
- **Ethical Use of Resources:** It takes a significant amount of energy to train AI models and to build and run the data centers that respond to queries. There are also reasonable concerns about whether some data used to train AI models was used without copyright permission. Please be mindful of your usage of AI tools.

Inclusivity: All students should feel welcome in Physics class. We all bring our own unique perspective 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 should address. I am still learning, too, and your feedback is important to me.

Accommodations: It is important to me that nothing impedes your ability to do well in this course. In order to receive consideration for reasonable disability accommodations, a student with a disability must consult with Accessibility Services https://hub.lafayette.edu/accessibility-services. Students approved for accommodations should discuss their accommodations and learning needs with me as early in the semester as possible. Students approved for exam accommodations are responsible for making exam accommodation arrangements with faculty *at least 7 business days* prior to *each* exam.

Moodle Privacy: 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.

Federal Credit Hour Statement: The student work in this course is in full compliance with the federal definition of a four credit hour course. Please see the Registrar's Office web site http://registrar.lafayette.edu/additional-resources/cep-course-proposal/ for the full policy and practice statement.

Andrew Dougherty Fall 2026
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Time	**Mon.**	**Tues.**	**Wed.**	**Thurs.**	**Fri.**
8:00 8:25 9:15					
9:30 10:20	**Phys 335** HSC 017		**Phys 335** HSC 017		**Phys 335** HSC 017
10:35 10:45 11:00 11:25					
11:40 12:15 12:30 12:55	**Phys 133** HSC 100		**Phys 133** HSC 100		**Phys 133** HSC 100
1:15 1:40 2:30		**Phys 130** **Lab** HSC 042	*Office* *Hours*		
2:45 3:35 4:00	*Office* *Hours*				
4:15 4:30		Committee Meeting	*Physics Club*		

ACADEMIC HONESTY GUIDELINES
Department of Physics

It is expected that each student taking courses in the Department of Physics is familiar with the statement "Principles of Intellectual Honesty" appearing in the Lafayette College Student Handbook. The following guidelines are intended to indicate how that statement pertains to your work in physics. Your instructor may have further guidelines for your specific course. We assume that students are honest; if you are not certain as to what is expected of you, consult your instructor before proceeding.

I. EXAMINATIONS:

1. Bring only those materials specifically authorized by your instructor. Frequently in the elementary courses, you will be permitted to bring in a formula sheet or you will be provided with one.
2. If you find that the seating arrangement is such that you can see someone else's paper, don't look! Better yet, ask if you can sit in another seat.
3. If you use a calculator, clear the answer before setting the calculator aside.
4. If you fail to hand in your paper at the end of the period you will be awarded a grade of zero for that test.

II. TAKE-HOME EXAMINATIONS: Take-home examinations are often assigned in some courses. Specific rules governing such tests will be announced by your instructor. The overriding principle, however, is that any work submitted be your own or be specifically credited to its source. There should be no discussion of the test questions with *anyone* other than the instructor.

III. HOMEWORK: You must acknowledge *all* collaborators. You are encouraged to learn from one another. You should first try to do homework problems on your own; after all you will have to do similar problems on your own in tests. However, discussion of difficult problems with others can help you to develop your own analytical skills and is encouraged, provided that, *after discussion* you write up solutions *on your own.* Do *not* borrow or lend homework papers. There is an important difference between discussing a problem with someone and copying his or her work. There have been students who have loaned papers to friends for a few minutes to "check answers", and been horrified to find themselves charged with academic dishonesty because their "friends" copied their solutions.

Please Note: The same ethical standards of academic integrity and honesty apply to the on-line homework as to the written homework, except that there is no place for you to specifically acknowledge collaboration. However, the same general rules apply.

IV. LABORATORY: Usually two or more students will work together in performing experiments and will submit reports of their work. In some courses, a single joint report may be submitted. Specific instructions will be announced by your instructor. If the words used to describe some part of the experiment are taken from some other source (such as the lab manual), then the source should be cited. (Reference to the lab manual can usually substitute for laborious copying.) If you consult with *anyone* about the experiment (e.g. students in your lab class other than your lab partner), that consultation should be acknowledged in your report. Do *not* borrow or lend a completed lab book or any portion of one.

V. PAPERS: Refer to the statement "Principles of Intellectual Honesty" in the Student Handbook.

Syllabus		Phys 133	Fall 2026
Aug.	24	Introduction; Coulomb's Law	Ch. 21:1–3
	26	Electric Forces and Fields	Ch. 21:3–4
	28	Electric Field Calculations	Ch. 21:5–6
	31	Electric Fields of Charge Distributions; Dipoles	Ch. 21:5, 7
Sept.	2	Electric Flux; **HW #1**	Ch. 22:1–2
	4	Gauss' Law	Ch. 22:3
	7	Application of Gauss' Law	Ch. 22:4–5
	9	Electrostatic Potential Energy; **HW #2**	Ch. 23:1–2
	11	Electric Potential	Ch. 23:3
	14	Equipotential Surfaces	Ch. 23:4–5
	16	Capacitance; **HW #3**	Ch. 24:1,3–5
	18	Capacitors in Series and Parallel	Ch. 24:2
	21	Electric Field Energy	Ch. 24:3–5
	23	**Exam I**	Chs. 21–24
	25	Current and Resistance	Ch. 25:1–3, 26:1
	28	Ohm's Law and EMF	Ch. 25:3–4
	30	Energy and Power in Circuits; **HW #4**	Ch. 25:5–6
Oct.	2	Kirchhoff's Rules	Ch. 26:1–2
	5	RC Circuits	Ch. 26:4
	7	Magnetic Fields; **HW #5**	Ch. 27:1–3
	9	Magnetic Forces on Charges	Ch. 27:4–5
	12	*Fall Break*	
	14	Magnetic Forces on Currents	Ch. 27:6–8
	16	Biot-Savart Law; **HW #6**	Ch. 28:1–4
	19	Ampère's Law	Ch. 28:5–6
	21	Applications of Ampère's Law; **HW #7**	Ch. 28:7
	23	**Exam II**	Chs. 25–28
	26	Faraday's Law and Lenz's Law	Ch. 29:1–4
	28	Induction and Maxwell's Equations	Ch. 29:5–7
	30	Induction and Magnetic Field Energy	Ch. 30:1–3
Nov.	2	Mechanical Waves Review	Ch. 15:1–5
	4	Superposition; **HW #8**	Ch. 15:6–8
	6	Sound Waves	Ch. 16:1–4
	9	Resonance; Interference	Ch. 16:5–7
	11	Electromagnetic Waves; **HW #9**	Ch. 32:1–3
	13	Energy in Electromagnetic Waves	Ch. 32:4–5
	16	Reflection and Refraction	Ch. 33:1–3
	18	Polarization and Scattering; **HW #10**	Ch. 33:4–7
	20	**Exam III**	Chs. 15, 16, 29, 30, 32, 33
	23	Interference	Ch. 35:1–3
	25–27	*Thanksgiving*	
	30	Diffraction and Diffraction Gratings	Ch. 36:1–5
Dec.	2	Thin Film Interference;	Ch. 35:4
	4	*Final review*; **HW #11**	
		Final Exam (cumulative)	

July 27, 2026