Physics 122 Syllabus

General Physics II: Electricity and Magnetism

Fall 2015

Topics: Charges, Electric fields, Potentials, Conductors, Magnetic Fields, Lorentz force law, Currents, Dielectrics and magnetic materials, Circuits, Induction, EM waves, Optics

Prerequisites: Physics 121, 123, or equivalent

Schedule:
Lectures – MWF 2:00-2:50pm
Lab – every other week, students must register for a lab section
SI sessions – scheduled independently

Instructors:

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Course Webpage:
Lecture – http://blackboard.case.edu
Lab – http://physicslabs.cwru.edu

Rubric:

Homework	20%
3 Midterm Exams	30% (10% + 10% + 10% *or* 5% + 10% + 15%, whichever leads to the higher final score)
Final Exam	25%
Lab	25%
Bonus points	2%

Goals of the course.

One of the goals of this course is certainly to have you understand the fundamental concepts of electric and magnetic fields. But I also hope that you will learn some problem solving skills useful in a broad range of fields, and how to think about the world in terms of basic and unifying ideas. I also do not want you to consider this course as just a dry collection of equations and abstract ideas; we will also talk about the massive number of technological ways in which electricity and magnetism influence your lives everyday.

Lecture Schedule.

Here is an approximate schedule for the course. There are 15 weeks to the semester, and each week is labeled by the Monday date for that week. Exam dates are noted but are tentative and will be confirmed well in advance. You have homeworks due almost every Monday, except when you had an exam the week before or when there are holidays, as noted below.

	Week	Mon. Date	Mon. HW Due	Topics	Important Dates
Cycle 1	1	Aug. 24		Charges, Fields	
	2	Aug. 31	HW1	Energy, Potential, Flux	
	3	Sep. 7	HW2*	Circuits, Magnets	No Class Mon. Sep. 7
	4	Sep. 14	HW3	Magnetic forces	Exam 1: Fri. Sep. 18
Cycle 2	5	Sep. 21		Coulomb's Law	
	6	Sep. 28	HW4	Capacitors	
	7	Oct. 5	HW5	Ampere & Biot-Savart	
	8	Oct. 12	HW6	Faraday's Law	Exam 2: Fri. Oct. 16
Cycle 3	9	Oct. 19		Inductors	No Class Mon. Oct. 19
	10	Oct. 26	HW7	Dipoles & Dielectrics	
	11	Nov. 2	HW8	Magnetic Materials	
	12	Nov. 9	HW9	EM Waves	Exam 3: Fri. Nov. 13
Cycle 4	13	Nov. 16		Light, Ray optics	
	14	Nov. 23	HW10	Optics Applications	No Class Fri. Nov. 27
	15	Nov. 30	HW11**	Waves, final review	

*HW2 is due on Wed. Sep. 9

** HW11 is due on Fri. Dec. 4 (last day of class).

Cyclic Approach.

The topic of introductory physics has been taught in more-or-less the same manner in colleges and universities across the country for decades. For Electricity and Magnetism, the material is traditionally presented in a *linear* fashion, starting with electric fields, moving into magnetic fields, and then combining them to develop the concepts of waves and optics. Each topic is introduced and then expanded upon fully before moving on to the next topic.

Pedagogically, the difficulty with the traditional approach is that students will generally cover a given topic only *once* in a semester, and without re-visiting the topic, even students

who do well on exams tend to lose comprehension later in the semester or even in future courses. The material does not "stick."

However, for most people material is learned through repeated exposure to ideas, re-visiting and expanding at several different points and different times. Generally, we need to see it, reflect on it, act on it, and then see it all over again before we really learn it.

To help students deepen learning in the course we are using a *cyclic approach* to Physics 122. The basic idea is that the course is divided into four *cycles*, each a few weeks long. During the first cycle we will cover an abbreviated, simple version of most of the course concepts, followed by an exam. We will then repeat the pattern in each subsequent cycle, looking more deeply into the material.

In *Cycle 1*, we will introduce the idea of point charges and consider electric and magnetic fields that result from simple charge and current configurations. We will also discuss basic resistive circuits.

In *Cycle 2*, we will look at some more complex charge and current configurations that require some calculus to analyze, as well as time-varying circuits.

In *Cycle 3*, we will apply these concepts to introduce Maxwell's equations for any configuration of charges and currents, and consider what happens when we have fields inside materials, and not just empty space.

In *Cycle 4*, we will use what we know about electric and magnetic fields to justify the existence of electromagnetic waves, and begin discussing optics.

In other words, we will see the same topic three or four times, each time revisiting what we learned previously before adding further details to increase the depth of our understanding.

This approach has many advantages, but one disadvantage is that the presentation of materials is not closely linked to the content and organization of any commercially available textbook. We will be using the text *Physics for Engineers and Scientists, 3rd Edition, Vol. 2* by Ohanian and Markert for reading. Reading assignments will "jump around" the text so as to match the presentation of materials in class. This may get confusing, so keep in mind that the lectures and homeworks define the content of the course, not the textbook. I do have my own set of lecture notes to help you organize the material in your mind.

Lectures.

Lectures are from 2:00-2:50pm Mondays, Wednesdays, and Fridays, and we will start and end promptly (most of the time). Most lectures will take place using the blackboard. It is a big auditorium, so if you having trouble reading the board, please let me know. There will be occasional demonstrations and frequent "clicker" questions to introduce or reinforce the materials, and to break-up the lecture. Lectures will be recorded by the University Mediavision team and available on the class Blackboard site. This is a great resource if you want to review material or if you cannot make it lecture because of an illness or emergency.

Lectures are not mandatory in that we will not take attendance or give quizzes, but you are *strongly encouraged* to make it every lecture. There is plenty of research that says students who skip lecture will not get nearly as much out of the course and will not do as well on the exams. *This is especially true since we are using the cyclic method.* Note also that if you skip lecture, you will also lose the opportunity for optional bonus points via clicker participation.

Textbook.

The recommended text is *Physics for Engineers and Scientists* by Hans Ohanian and John Markert, vol. 2, 3rd ed., 2007. I will post to Blackboard suggested sections of the textbook to read before class. This will help you prepare for lecture and to know what to study for the exams. The textbook is not required, you will not be quizzed on the readings nor will I give you homework problems from the textbook. I do have my own set of brief lecture notes that I will post periodically, but they are designed more for review and as a quick reference.

Even with my lecture notes, I do strong recommend that you buy this or another textbook, as a proper textbook has more detail with many practice problems. If you come to me concerned about your performance, the first question I will ask is whether you have the textbook and if you are doing the practice problems. If you wish you may substitute another textbook at the same level such as *Fundamentals of Physics* by Halliday, Resnick, and Walker, vol. 2, 10th ed., 2013 or *Physics for Scientists and Engineers with Modern Physics* by Serway and Jewett, 9th ed., 2013.

Clickers.

We will use the Turning Technologies clicker system, which you may have already used in Physics 121. I will ask multiple choice questions during class which you can respond to using the clickers. I will use these in the most of the lectures, and they are a good way for you to let me know if we need to spend more or less time on a topic. Answering these questions is not required, but will earn you bonus points. At the end of the semester, there are always a few students who fall just below a grade borderline, and could have earned the higher grade had they answered the clicker questions.

I will discuss in class how to respond to the clicker questions and what you need to buy. I do not recommend buying anything before the first day of class. There will be a document on Blackboard with more details on how to get setup and use the technology. I will let you know after a couple weeks if you are earning bonus points.

Homework.

There will be 10-12 homework assignments due throughout the semester. The assignments will be posted to Blackboard about one week before the assignment is due. All HW is due by 4:00pm sharp on Mondays (with a few exceptions for holidays). It can be turned in during class or to a brown box that will be placed outside of Rockefeller 208, directly to the left. This deadline will be strictly enforced and no late homework will be accepted. Exceptions can be made in cases of personal emergency, illness, or off-campus event, but only if you contact one of the instructors before the due date. You should contact us in any case, before or after the due date, so we aware of your situation.

In calculating your aggregate homework score for final grades, your two lowest scores will be dropped. This is to account for cases of emergencies or times where you may be too busy to do your best work. If you experience a multitude of personal emergencies that prevent you from turning in numerous HW assignments, contact us to make arrangements.

Not all of the problems on the homework will be graded, but you should still attempt all of them. Solutions to all of the problems will be posted to Blackboard shortly after the assignment is due. They will be graded generally within one week and will be returned to the individually labeled folders in the bins outside of Rockefeller 208.

Collaboration on homework is permitted and encouraged, as it can help you learn from each other. You may discuss problems with other students, with the instructors, and with the SI leaders. However, you must write up the answers on your own. Outright copying of another student's work, or letting your work be copied, does not constitute collaboration and will not help you learn the material; it is plagiarism and is not acceptable.

Finally, we cannot over stress the importance of doing the homework. Putting aside the focus on grading, due dates, missed assignments, and so on, it's essential that you tackle each and every problem. The only way to learn physics (or pretty much any subject) is by active engagement and practice, and homework problems will be used as the basis when writing exam problems.

Exams.

There will be three midterm exams during the semester, which will take place during class time in Strosacker. These are tentatively scheduled for Sep. 18, Oct. 16, Nov. 13. They will be closed book, but you may bring one handwritten, 8.5" x 11" page of notes. No equations will be provided for you unless they are particularly specialized. You may also bring a calculator but are unlikely to need it. Paper for writing your answers will be provided.

Each midterm exam is worth 10% of your final grade. However, if it helps your final grade, exam 1 may be decreased to 5% and exam 3 increased to 15% (exam 2 will be worth 10% in all cases). This is to help those students who do not do as well as they want during the first half of the semester, but work hard to improve their performance. Exams will be graded generally within one week and returned in class.

Students are expected to make every effort to attend exams as scheduled. If you know ahead of time that you will not be available for an exam due to academic or athletic travel, you must contact the instructors at least 2 weeks before the exam to make arrangements. Even if you are not sure you will be making the trip, still contact the instructors 2 weeks ahead of time. Students who have a personal emergency (accident, illness, etc.) must contact the instructors as soon as they are able, and provide some documentation, before a make-up exam will be considered. Students who have to travel for personal reasons or merely oversleep will not be allowed to make-up an exam.

The final exam is scheduled for Mon. Dec. 14^{th} from 4 to 7pm at a place to be determined. The final constitutes 25% of your grade. The rules for the final are the same as for the midterm exams. If you do not attend the final exam at the scheduled time you will automatically fail the class. In accordance with University policy, only the Dean of Undergraduate Studies can authorize an excused absence from the final exam. If you believe you might miss the final exam for any reason you need to contact the Dean's office

directly – not the instructors. Note that the Dean will not authorize make-up final exams to accommodate early departures from campus for the winter holidays.

Labs.

Students must register separately for the labs, but your score in lab is part of your final score for this class. It is worth 25% of your grade, as much as the final exam, and doing well on the labs is an excellent way to increase your overall score in the class (and blowing off lab is an excellent way to decrease your score). Prof. Driscoll handles all aspects of the labs, so please see her if you have any questions. More information is provided in the document Lab_info.pdf on Blackboard and on the dedicated lab site: http://physicslabs.cwru.edu.

Grading Policies.

As a rough guide for final letter grade assignments: A = 90% and higher, B = 80-90%, C = 70-80%, D = 60-70%. At the end of the semester, we will compile the distribution of scores for the entire class and adjust the grade boundaries. This means you are not given letter grades on individual homeworks or exams, only at the end of the semester. To some extent this is a "curve", but we do not have fixed quotas for the number of students who will get each letter grade. Adjustable grade boundaries are used primarily to account for the possibility that a particular assignment or exam was exceptionally long or difficult. Thus, we cannot provide a "rolling" letter grade, but if you are concerned about your performance please meet with one of us to discuss. Approximate letter grades are also given at the mid-point of the semester to provide further feedback.

The rubric also contains an extra 2% of credit for bonus points. These will be added directly to your final numerical score after all other calculations, so in principle it is possible to get 102% in the course. Bonus points cannot reduce your grade, but may bump you up if you are close to a grade boundary. Bonus points will primarily come from in-class clicker questions. Also, we will not strictly grade the accuracy of your answers – your total bonus points will be at our discretion and will be based on some combination of fraction of questions that you answered (to encourage participation) and correct answers (to encourage *thoughtful* participation).

Office Hours.

Meeting individually with students is one of the best parts of teaching. Both Profs. Christenson and Matas will hold regular office hours throughout the semester. The specific dates, times, and places will be determined near the start of the semester, and posted to Blackboard. Office hours provide an opportunity to interact with the instructors one-on-one, which is especially beneficial for a large class. They can be a benefit whether you are doing well in the course or not.

Contacting Instructors.

Office hours are times when we are guaranteed to be around, but if you know you are going to stop by at some time, it can help to send a quick email. We will generally be available at other times outside of specific office hours, so please feel free to come in if our doors are open or email to arrange a time. Our office phone numbers are also on the first page of the

syllabus. We both check email very often, but make it clear you are student in P122. Also, do not expect a quick response if you email after about 9pm. I encourage you to catch us after lecture if you have a quick questions, but it is best to send a follow-up email.

Supplementary Instruction Leaders (SIs).

Another extremely valuable resource for students are the Supplementary Instruction Leasers, which are top-ranked upper class students who have been hand-picked by the office of Educational Services for Students to act as "peer tutors" for major classes. We will have two SI Leaders: Nicole Thompson (nlt16@case.edu) and Catherine Boulos (csb82@case.edu). The SI Leaders will usually hold three informal study sessions throughout the week. They be run independently of the department, and can be very helpful when students need extra help with homework or in preparing for exams. Schedules for SI review sessions will be announced in lecture and through email.

Studying Tips.

Here is some common sense advice on how to study. Although some of these are obvious, they bear repeating. (1) Come to class and pay attention. It will save you an incredible amount of time if you can learn material directly from the lectures. (2) Do all the homework and practice problems, even if you plan on having one particular homework assignment dropped. Make sure you understand all of them fully. (3) An hour of work when you are well rested is worth many hours under conditions of sleep deprivation. Give yourself plenty of time to do the homework. Don't save it up for the night before it's due. (4) Doing practice problems is perhaps the best way of learning the material. Physics is about problem solving, not about memorization. The textbook (any textbook) is an excellent source of practice problems, but some will also be provided to you throughout the semester.

Majoring in Physics.

If you want to be a physicist, there is no better major than physics. But it is a remarkably good major even if your long term interests lie elsewhere. Physics majors are consistently the top performers or close to the top on the MCAT and LSAT exams. At CWRU, our majors have gone on to graduate school in fields that range from Mathematics and Engineering to Nursing and Law. Nationally, approximately 50% of all physics majors go on to graduate school. Typically, a larger fraction of our majors have gone on to graduate school, approximately 2/3 of them in physics and the rest in other fields. Physics majors who join the workforce directly after their undergraduate degree pursue careers in diverse fields, notably engineering and finance. Recognizing the varied interests of physics majors, the Physics Department at CWRU offers a number of different physics degree programs. More information about our degree programs is on the department website at http://www.phys.cwru.edu/undergrad/programs/. You may also wish to contact Prof. Gary Chottiner (gsc2@case.edu) for information about the BS and BA in Physics, Prof. Harsh Mathur (hxm7@case.edu) for information on the BS in Mathematics and Physics and BS Mathematical Physics Concentration, Prof. Michael Martens (mam18@case.edu) for information about the Engineering Physics major, and Prof. Robert Brown (rwb@case.edu) for information about the BS Biophysics concentration.