

SYLLABUS

What is Electricity and Magnetism?

Physics 1121 (Electricity and Magnetism) builds upon Physics 1111 (Mechanics) in the calculus-based sequence of introductory physics at WPI. Instead of inquiring about electricity and magnetism, as *separate* entities, I could have easily asked *what is light?* While the questions of *what constitutes* light and *how does it behave* will be further addressed in subsequent physics courses (i.e., PH1130 and PH1140), in this course, we will ultimately aim to dissect the question *how is light formed?* Specifically, we will explore preliminary concepts pertaining to electricity (i.e., charge, conductors, insulators, electric fields, Coulomb's Law, Gauss' Law, potentials, capacitance), including circuits (i.e., current, resistance, emf, Ohm's Law, Kirchoff's Rules, RC Circuits). These preliminary concepts will lead to the development of a coherent understanding of magnetism (i.e., moving charge, magnetic fields, Biot-Savart Law (BS Law), Ampere's Law, induction, magnets, electromagnetic waves). And, the sum of all of these parts bridges to Maxwell's Equations. Of course there's more to the story, but I'll *leave that as an exercise for the interested reader*[cite your favorite journal article here].

How will we investigate Electricity and Magnetism?

Given that you read the text, attend and participate in both lecture and conference, learn the homework, and participate in lab (**REQUIRED TO PASS**), you will develop a deeper understanding of the principles of electricity and magnetism.

1. Read the book:

Lecture material will reflect and *supplement* the material presented in our required text for the course: *Fundamentals of Physics, Eighth Edition*, by Halliday, Resnick and Walker (available at the book store). The book encourages scientific inquiry by prefacing each chapter with a question. I challenge you to find or even explore possible answers to each and every proposed question. In fact, some of your homework sets **will** contain qualitative (conceptual-based) questions.

2. Attend and Participate in Lecture:

My research is deeply-rooted in physics education/pedagogy. For over twenty years, there has been (and it continues to grow) a significant amount of research which serves as evidence that non-traditional modes of teaching promote effective learning. This basically requires that both the students and person teaching the course remain active, and not passive. In lecture, I will certainly bombard you with a lot of information, but I will encourage you to equally bombard me with a lot of questions and dialogue. This course will encourage peer learning and group work.

There are other incentives or factors which motivate participating in lecture. From time to time, I will give you gapped-lecture notes. As the name suggests, there will be missing details in these notes so that you will have to "fill-in" the necessary information by actively attending lecture. In addition, I will do some interactive lecture demonstrations (but not too many because nobody really understands anything presented in ~2 min.) and cool computer simulations, and will then ask you for direct and immediate answers (sometimes predictions). It is my intent that these added resources will help you prepare for the upcoming homework sets and in-class activities.

3. Attend and Participate in Conference:

While I will try to mesh problem solving in lecture, I will not always have enough time to spend identifying useful strategies. Consequently, it is equally important that you actively attend conference. Your Conference Instructors are Professor Kashuri (hkashuri@wpi.edu), Professor Koehler (sak@wpi.edu), and Professor Zozulya (zozulya@wpi.edu). In the PH1121 Schedule, notice that there are **eight** Interactive Sets (15% of grade), and ALL except for one are scheduled during Conference. These sets will encourage you to do group work and will require your feedback, in the form of a survey, at the end of the course. The aim of the Interactive Sets is to promote teamwork skills (crucial for upcoming IQPs and MQPs) and I will design Interactive Sets that are isomorphic to upcoming homework problems and exam questions. **Solutions to these problems, in addition to homework problems, will be posted on our website:** <http://www.wpi.edu/~ck/teaching1.htm>.

Since PH 1121 is a much smaller populated course (compared with PH 1120, B Term), I will assign students to groups and will identify a scribe (a person who records the agreed upon solution) for each group. Also keep in mind that because these graded activities involve class (group) participation, it is critical that you attend these sessions.

4. Learn the Homework:

While problem solving is essential for what some may term 'putting theory to practice,' it is not always indicative of comprehension of the material studied, especially in the case of 'plug-and-chug' type problems. Properly assessing, or measuring, what we have learned from a particular course requires engineering (crafting) the 'right' sort of exam, or sets of questions. In light of this matter, I will assign problems/questions/exercises that test you on the concepts and will sometimes simply ask you for a question you encountered while reading the chapter, working on the homework, reviewing for the exam, etc.. **Homework assignments (and solutions) will be posted at:** <http://www.wpi.edu/~ck/teaching1.htm> and will be distributed in lecture.

Keep in mind that you are encouraged to work on homework with other students in the course, and I will encourage groups to meet outside of class to discuss homework and study for exams. In fact, this will help prepare you for the Interactive Sets you will do in class. As a cautionary remark, pay careful attention that you are doing more than just 'doing the homework.' Learn it. Put yourself in the 'driver's seat.'

5. Participate in Lab:

Lab is a requirement for this course and it is required that you **attend all** experiments and **submit all** reports.

From a previous research project, I interviewed graduate students in physics at Brown University, and asked them how they would define physics. One student's response nicely illustrates the symbiotic relation between theory and experiment: "physics is the study of trying to build things to fit subtle data." To take his definition a step further, I would add that technology cannot progress if one of these two elements (theory, experiment) is missing. In short, this means you cannot develop or create a solid understanding of electricity and magnetism if lab or lecture is missing from your study.

6. Comprehensive Group Project: The purpose of the Comprehensive Group Project is to unify previous concepts of 1121 with current concepts. Project topics will be decided upon by a first-come-first-serve basis. It is therefore important that you and your group members communicate and work well as a team! More details to come.

7. Problem of the Week: We will have a series of problems (throughout the term) to enable you and your group members to earn extra credit on your Interactive Set average! If you are the first group to hand in the correct solution, then you receive five points to the sum of your Interactive Set Work. If you are the second group to hand in the correct solution, your group receives four points; if you are the third group to hand in the correct solution, your group receives three

points...if you are the fifth group to hand in the correct solution, your group receives one point; and, if you are the sixth or beyond group, then you are too late (sorry)! Since you will be asked to submit your solutions to either Mrs. Malone or Mrs. Caisse, in room 118 of Olin Hall, they will record your submission time. The philosophy behind *PROBLEM OF THE WEEK* is simple: a chance for you to learn about how fundamental principles of electricity and magnetism are integrated with technology, and how physics concepts in mechanics can be used to explain electromagnetic phenomena. It's also yet another way to potentially help your grade in the course.

How can I assess what I have learned about electricity and magnetism?

Your grade in PH1121 will be determined as follows:

- 45% Exams* (3 total, please see schedule) **NO MAKE-UP EXAMS****
- 15% Interactive Sets (8 total, please see schedule) **ATTENDANCE IS REQUIRED**
- 15% Homework (6 total, please see schedule) **NO LATE SUBMISSION****
- 15% Comprehensive Group Project **NO LATE SUBMISSION****
- 10% Labs (**REQUIRED**) **LATE LABS ARE SUBJECT TO PENALTY*****

*My grading on exams, Interactive Sets, and homework will be based on the following scheme:

After I devise a list containing all of the essential physics of the solution (including units!), if the student has:

- **all** of the essentials and the correct solution the grade is a **10**
- **more than half** of the essentials and a '*correct*' final answer (i.e., two wrongs made a right somewhere in the solution) the grade is between **7 – 9**, depending on the severity of the error(s)
- **more than half** of the essentials and an *incorrect* final answer the grade is between **7 – 9**, depending on the severity of the error(s)
- **less than half** of the essential physics (independent of the final answer) the grade is less than 5, depending on how many mistakes occur (zero if there's no solution)
- **exactly half** of the essential physics the grade is 5

Note: For problems having multiple parts (a, b, c, etc.): if a student has made an error in *part a*, which is needed for *part b*, then I will not double-count that mistake **if the essential approach to the problem is correct (propagated error)**.

Due to the intense scheduling of the course, it is virtually impossible to offer make-up exams, and again due to time constraints, late homework will **not be accepted. If you are unable to take an exam, or if you are unable to submit homework, due to an extenuating circumstance, I will ask you to provide documentation directly issued by the school. And only in such cases will I either issue a make-up exam, or accept an assignment. Interactive Sets are completed during class time and so missing one of these classes means you will receive a grade of zero for that assignment.

***For further questions concerning the lab, please consult Prof. Hutson: Olin 213 A, or flh@wpi.edu. **For any questions on the lab material please email your lab TA!** Deadlines for the labs will be posted on the website:

<http://www.wpi.edu/Academics/Depts/Physics/Courses/Labs/>. Information on each of the labs can be found at: <http://www.wpi.edu/Academics/Depts/Physics/Courses/Labs/LabNotes-2009-A.html>.

Where can I get help for the course?

My office is in Olin 127 (first floor), and you may also reach me via phone with voice mail (508-831-6018) and email (ck@wpi.edu). As you can see from the syllabus, we will be learning a great amount of physics in a relatively short amount of time (seven weeks!). **Please do not wait until the very last minute to seek course resources.** You are welcome to attend my office hours (M, W, F: 10 AM -12 PM; unless otherwise noted), or we can always schedule an appointment. Either way, I will try my best to help you and want you to succeed.

If you would like another perspective on your questions, I would encourage you to visit the physics library (Olin 118). In Olin 118, you'll see a sign that says "physics help" and either a physics undergraduate or graduate student will be nearby, eagerly awaiting your question! On the library door, a schedule is often posted so please refer to that for possible times to receive help from undergraduate and graduate students.

You should also take advantage of MASH, Math and Science Help. Mr. Zhen Chen, an outstanding physics student, is eager to help with your questions.

Throughout the term I will be posting supplementary information on our web site, including the gapped-lecture notes (remember that if you are to fully benefit from this resource, then you need to be there to fill-in the details). So please be sure to visit the site on a regular basis. Once I update our web site with new material, I will of course make the announcement in lecture or conference. However, you can always get a sneak preview by visiting the site frequently. **Please do not hesitate to contact me if you spot any typographical errors, or if you have any questions!**

Trailing words of wisdom...

Physics is really $F = \mu N$ and I am going to do my best to convince you this is really true, in case you have not already discovered this beforehand. Sometimes I will make analogies to previous concepts you explored in introductory mechanics, while other times I will try to offer clear and concise examples from other disciplines, with numerous questions along the way. When all is said and done, I hope you will find PH1121 to be one of the best (if not the best) introductions to the *light at the end of the tunnel*. Remember, as Thomas Jefferson (1743 – 1826) once said, "*I find that the harder I work, the more luck I seem to have.*"