Syllabus for Physics 111: Electricity, Magnetism, and Thermodynamics, Spring '07

Basic information:

•**Course prerequisites:** passing grades in PHYS 110 or the equivalent and Math 134 or the equivalent. **If any of these assumptions aren't true and you haven't talked to me yet, please see me soon! Also note: MATH 231-Multivariable Calculus is HIGHLY recommended and required for the next course in the sequence PHYS 212.** If you have any thoughts of continuing in physics, engineering, or math, you should take MATH 231 too. It is also highly desirable for physical chemistry as well.

•**Course website:** Information about assignments and the like will be available on the course website on Blackboard.

•**Textbook:** The required textbook for this class is the same as in PHYS 110, Halliday, Resnick, and Walker, *Fundamentals of Physics: Extended (or standard)*, 7th edition (Wiley, New York, 2005). I encourage you to look at other textbooks that may have clearer explanations of the same information-see the list of books placed on reserve.

•**Instructor, lecture:** Ms. Yumi Ijiri
Wright 216
Phone: 775-6484
Email: yumi.ijiri@oberlin.edu

•**Instructor, laboratory:** Mr. John Scofield
Wright 210
Phone: 775-8333
Email: john.scofield@oberlin.edu

•**Lecture hours and location:** 9:00-9:50 am, MWF in Wright 201.

•**Laboratory hours and location:** 1:30-4:30 pm, Tu, W, or Th in Wright 214.

•**Extra sessions:** Tentatively Monday at 1:30 pm and Tuesday at 11:00 am in Wright 102A (the seminar room). These sessions are *optional*, a chance to discuss other physics topics or problem-solving methods as well as to meet up with other members of the class.

•**Office hours:** Tentatively Thursday at 11:00 am and another hour or two to be set later. A chance to discuss more personal or specific concerns you might have. Also, just feel free to drop by—Tuesday and Thursday mornings are pretty free as well as Monday afternoon.

Detailed description:

•**Objectives:** This course serves as a continuation of PHYS 110-Mechanics and Relativity. As in PHYS 110, the aim of this course is to help you understand some of the essential physical concepts used to describe the world around us. The emphasis is again on developing problem solving skills and physical insight as opposed to memorizing facts and equations. More specifically, the course objectives are to:
1) increase your knowledge about the topics of electricity, magnetism, and thermodynamics
2) increase your problem solving ability, for instance how to break up a problem, or use symmetry and superposition
3) increase your mathematical sophistication
4) increase your practical understanding, learning how big is a volt, how you can avoid electrocution!

An important caveat: While this course is the continuation of PHYS 110, there are several significant differences. The level of mathematics will be more advanced relative to PHYS 110 and the topics for this course (electricity, magnetism, and thermodynamics) tend to be more abstract than mechanics. In addition, the format of three lectures + one lab is quite different. (We'll ask for your thoughts on this, whether to alter 111 to match 110—previous classes have reached no consensus on this…)

•**Course design:** In order to achieve the course objectives, the course stresses to a large degree the ability to solve problems-in the context of lectures, problem sets, laboratory classes, and exams.

Lectures: In lecture, we will discuss key features of the different concepts pertaining to electricity, magnetism, and thermodynamics. Demonstrations and class questions (which I pose or you ask) will be included to facilitate this. I will also try to provide some context for the work we're doing (as in what's this good for? do people really need to know what an ampere is?) For each Friday, I will assign some questions for you to consider in advance of class that will serve as the basis for some discussion. Send your responses to me via Blackboard before class on Friday, along with any other concerns you might have. The department has just invested in some "clickers" to answer questions in class and so we'll experiment with them a bit--9 am is really early I realize so I'm willing to try anything to wake us all up!!

Guest lectures: The physics and other departments invite visiting scientists to speak at Oberlin on a bimonthly, monthly basis. I will keep you informed as to when these talks occur. They are an excellent opportunity to learn where your physics training might take you or rather what scientists today are studying. You might not understand all or sometimes even much of the talk, but I might not either! If you attend a guest lecture and within a week of the talk email me a one-paragraph description of it, I will augment your problem set score (bonus points, as if you solved another problem).

Problem sets: Homework assignments will be made on each Monday, with your solutions to be handed in the **following Wednesday at the beginning of class** (i.e. 9 days later). Please write and sign the honor code "I affirm that I have adhered to the honor code in this assignment." Late homework will not be accepted without specific, advance (at least 24 hr.) permission (and then, only under special circumstances). **It is very important that you stay on top of the material!** I encourage you to work with other students on the problem sets, particularly after you have made a first attempt. However, the solutions you hand in should represent your own understanding of the material-make sure it is clear how you have proceeded from one step to the next. Please indicate any help or sources you may have used outside the textbook and your class notes. For instance, write something like "after discussions with Student Al Einstein and the textbook *Physics problems solved for you*."--failure to do this may constitute an Honor Code violation (as in you plagiarized by copying verbatim from another source without proper citation.) Don't expect to get a 100% each time--the problems are meant to challenge you!

Laboratory: The laboratory experiments for this class are designed to illustrate and complement the discussion in lecture, as well as give you experience with important pieces of equipment such as multimeters and oscilloscopes. You should already have registered for a laboratory section for this course that will meet in Wright 214 from 1:30 to 4:30 p.m. on Tuesday, Wednesday, or Thursday afternoons. The first lab meeting will be mostly organizational, an intro to what is to come, with some more questions about your background and the like. Experiments will start the following week. Mr. Scofield will go over with you the specifics of the laboratory section.

Exams: There will be three 50 minute in-class exams (**Wed. Feb. 28, Apr. 4, May 2**) and the final 2 hr exam (**Thurs. May 17, 9-11 am).** The exams will be closed book and emphasize problems of the sort discussed in class and in the problem sets (although shorter to accommodate the time pressure). At least one question will try to draw on your experiences in lab or similar class demonstrations. To each exam, you will be permitted to write whatever notes you feel are necessary on one side of a standard 8 1/2 x 11 inch piece of paper. Calculators are permitted, but do not store in memory any additional information (just write in on your sheet of paper) or use it as a mini-computer (don't graph with it, perform integrals, etc.)

•**Additional information:** Below is some information concerning grading for the course, accommodations for students with special needs, and other sources of assistance.

Grading: Your final grade will be based on your work as follows: 3/5 on exams, 1/5 on homework and class participation, and 1/5 on labs. For the exam percentage, I will drop your lowest score (one of the hour exams or 1/2 of the final-the final counts double). That is if you received scores of 70, 75, 80, and then 85 on the final, I would average 75, 80, 85, and 85. On the other hand, if you received scores of 85, 80, 75, and then 70 on the final, I would average 85, 80, 75, and 70. In general, somewhere between 80-85% or higher will be an A, and you should expect to get >50% to receive a passing grade.

Accommodations for students with special needs: If you are a student with a learning disability or other special needs, I encourage you to talk with me early in the semester about the course. We may need some advance notice to work with Jane Boomer in Student Academic Services to assure that the proper paperwork is in place so that necessary accommodations can be made.

Other resources: In addition to the scheduled problem sessions and office hours, if you think you need more one-on-one help, please stop by Student Academic Services and pick up a tutoring card. I'll sign the form and help you identify another student (physics major) to act as a tutor.

Reserve reading: I also encourage you to look at other books for different/better? explanations. Specifically, several other texts will be placed on reserve for you to refer to in addition to Halliday, Resnick, Walker and its supplements:

- Feynman, Leighton, Sands, The Feynman Lectures on Physics, vol. 2
- Purcell, Electricity and Magnetism
- Sears, Zemansky, Young, University Physics (6^{th} edition)
- Tipler, Physics

along with some guide books:

- Browne, Schaum's outline of theory and problems of physics for engineering and science
- Polya, How to solve it

• **Topics and schedule:** Below is a list of topics to be covered for this class, along with the dates for assignments.

Date	**Topic:**	**Notes:**
Week 1	*Electrostatics*	
Feb. 5	1. Introduction, basic properties of electric charge	receive Assignment 1
Feb. 7	2. Coulomb's law (cont.) and the concept of an electric field	
Feb. 9	3. Calculating electric fields	**warmup 1**
Week 2	*Electric fields and potentials*	
Feb. 12	4. A more elegant way? Gauss' law I	receive Assignment 2
Feb. 14	5. Gauss' law II	**hand in Prob. set 1**
Feb. 16	6. Electric potential and potential energy	**warmup 2**
Week 3	*Electric potentials and capacitors*	
Feb. 19	7. More on the potential (watch that sign!)	receive Assignment 3
Feb. 21	8. Basic properties of capacitors	**hand in Prob. set 2**
Feb. 23	9. Capacitors II-in circuits and other uses	**warmup 3**
Week 4	*DC circuits*	
Feb. 26	10. Current and resistors	receive Assignment 4
Feb. 28	**EXAM 1 on Chap. 21-24 (up to capacitors)**	no Prob. set for 3
Mar. 2	11. Circuit basics	**warmup 4**

Week 5	*More on DC circuits*	
Mar. 5	12. Multiloop circuits and Kirchhoff's law	receive Assignment 5
Mar. 7	13. RC circuits-time dependence	**hand in Prob. set 4**
Mar. 9	14. Introduction to magnetic field; Magnetic force on moving charges	**warmup 5**
Week 6	*Magnetic fields*	
Mar. 12	15. Forces and torques on currents	receive Assignment 6
Mar. 14	16. Calculating magnetic fields-Biot Savart Law	**hand in Prob. set 5**
Mar. 16	17. A more elegant way? -Ampere's Law	**warmup 6**
Week 7	*Connecting electric and magnetic fields*	
Mar. 19	18. Inducing current	receive Assignment 7
Mar. 21	19. Making E by changing B	**hand in Prob. set 6**
Mar. 23	20. Inductors and their uses	**warmup 7**
	SPRING BREAK	
Week 8	*Magnetism in matter/AC circuits*	
Apr. 2	21. Magnetic fields in matter	receive Assignment 8
Apr. 4	**EXAM 2-Ch. 25-29**	no Prob. set for 7
Apr. 6	22. AC Circuits I-qualitative behavior	**warmup 8**
Week 9	*More on AC circuits*	
Apr. 9	23. AC Circuits II-quantitative behavior	receive Assignment 9
Apr. 11	24. AC Circuits III-the RLC circuit	**hand in Prob. set 8**
Apr. 13	25. Maxwell's equations	**warmup 9**
Week 10	*EM Waves*	
Apr. 16	26. Electromagnetic waves	receive Assignment 10
Apr. 18	27. More properties of E&M waves	**hand in Prob. set 9**
Apr. 20	28. Reflection and Refraction	**warmup 10**
Week 11	*Temperature/heat capacity*	
Apr. 23	29. Temperature and heat capacity	receive Assignment 11
Apr. 25	30. First law of thermodynamics-heat and work	**hand in Prob. set 10**
Apr. 27	31. Ideal gases	**warmup 11**
Week 12	*Kinetic theory*	
Apr. 30	32. Kinetic theory	receive Assignment 12
May 2	**EXAM 3-Ch. 30-33 (Electromagnetism)**	no Prob. set for 11
May 4	33. Degrees of freedom and more kinetic theory	**warmup 12**
Week 13	*Entropy*	
May 7	34. Entropy and the 2^{nd} law of thermodynamics	receive Assignment 13
May 9	35. Entropy and engines or other devices	**hand in Prob. set 12**
May 11	36. The grand finale? A review and look forward	**warmup 13**
	FINAL EXAM-Thurs. May 17, 9-11 AM	