Physics 110b. Electricity and Magnetism. Professor Dine

Spring, 2008. Syllabus

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Office hours: Monday 1:00-3:00 or by appointment.

Course website: go to department website and click on Dine, or go to http : //scipp.ucsc.edu/$\tilde{}$dine Homework and solutions and handouts will be posted here.

Course Description:
Last quarter, you learned the basics of electrostatics, and encountered the full set of Maxwell's equations. In this course, we see Maxwell's equations in action. We first study the momentum and energy of electromagnetic fields, and come to appreciate that the electric and magnetic fields are independent dynamical entities. We then study waves – the critical feature of electrodynamics which emerges from Maxwell's equations. We will then turn to the fields created by moving charges, and conclude with an in depth look at special relativity.
This is a tough course. It is important to devote a lot of time to it. You will need to keep up with the reading. The reading has to be done in a very active way, with pen and lots of scrap paper ready. Similarly for review of class notes. The problem sets are challenging. You should plan on attending section and office hours.
Grading As last quarter, you must submit something for all but three problem sets to pass the course (There will be approximately seven problem sets). Homework will count approximately 20% of the grade; the mid term and any quizzes 40%. The final will count 40%.
Note on the text: Griffiths provides a quite sophisticated treatment of electromagnetism. We will follow the text rather closely, but I will sometimes diverge from the text in lectures, and I will often provide supplementary materials.
Books on Reserve:

1. Feynman lectures volume 2. While nominally less advanced, Feynman's insights into the subject are extraordinary; I urge graduate students to use the Feynman lectures in preparing for their qualifying exams. I may provide handouts from Feynman from time to time.

2. Jackson, Electrodynamics – this is the standard graduate level text. As you'll see, you are not too far behind.

3. Corson and Loraine, Electromagnetic Fields and Waves. I like this book, mainly because it was my junior level text.

4. Boas, Mathematical Methods in the Physical Sciences. This book provides useful mathematical background.

I will put other books on reserve from time to time as seems appropriate.

Homework, exams,etc: There will be a problem set about once per 1.5 weeks. There will be an in class mid term and final.

Tentative Schedule; will be updated as quarter progresses

It is important to do the indicated reading.

1. Week 1 (April 1,3). Chapter 8, Conservation Laws. We will see that the electric and magnetic fields carry momentum, energy and angular momentum. These fields are dynamical entities in the same sense that particles are. In some ways, more so.

2. Week 2 (April 8,10). Chapter 9, Electromagnetic Waves. Sections 9.1 and 9.2. (Wave Basics). Wave phenomena are where Maxwell's equations come into their own (it was Maxwell's addition of the displacement term which led to his prediction of radio waves). We will first consider general aspects of the phenomena.

3. Week 3 (April 15,17). Chapter 9. Sections 9.3-9.4. (Waves in Matter, absorption and dispersion). Waves in matter are more complicated than waves in vacua. We will develop a deeper understanding of dielectric and other phenomena than you have had in the past.

4. Week 4 (April 22,24). Completing chapter 9 (9.5, waveguides). Chapter 10. Potentials and Fields. Sections 10.1. Here we will develop techniques to solve Maxwell's equations in the presence of time-varying charges and currents.

5. Week 5 (April 29, May 1). 10.2, 10.3.

6. Week 6 (May 6,8). Chapter 11. Radiation. Section 11.1. Radiation is one of the most important problems in physics. In simple situations, it is not so hard to understand.

7. Week 7 (May 13,15). 11.2. Begin chapter 12. Electrodynamics and Relativity. Section 12.1. Special relativity, Lorentz transformations. Maxwell's equations are Lorentz invariant. This is something Einstein appreciated very early on, and was perhaps the first to take seriously. We will first follow your text and develop the Lorentz transformation and related ideas.

8. Week 8 (May 20,22). Section 12.1. Begin 12.2 relativistic mechanics.

9. Week 9 (May 27,May 29). Section 12.2. Relativistic mechanics.

10. Week 10 (June 3,5). Section 12.3. Relativistic electrodynamics. Here we will see the relativistic character of Maxwell's equations.