SYLLABUS
Physics 431

Electricity and Magnetism
Physics 431 (Section 73715)
Fall, 2003 TR 8:10-9:25
Rm 304 Physics

Text: *Introduction to Electrodynamics, 3rd Edition*
David. J. Griffiths

Instructor:
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Introduction:
This intermediate level course in classical electricity and magnetism is one of the “core courses” of the undergraduate curriculum in Physics. The course is challenging because you will be learning not only new physics related to electricity and magnetism itself, but also more general concepts and mathematical methods related to the description of fields. In particular:

- You will learn E&M at the level that it is most often used in experimental physics and practical applications.
- You will get your first serious introduction to the field concepts that are used almost universally in more advanced theory.
- You will learn and apply the mathematical methods of vector calculus, which is the natural mathematical language needed to describe fields.

In addition, E&M provides a critically important bridge to many topics in modern physics.

- When formulated appropriately, E&M is the only classical theory that is relativistically invariant, so that it provides many insights into special relativity. It may be more accurate to say that special relativity provides insight into E&M because you can, for example) combine Coulomb’s law for the electric field (or potential) of a static charge with relativistic transformations to a frame in which the particle is moving to generate the equations for both the electric and magnetic fields of the moving charge (or potentials).
- The quantization of the theory of the electromagnetic field to create quantum electrodynamics (QED) very successfully united the “wave” and “particle” properties of electromagnetic phenomena and provided the prototype for all modern field theories.
**Course Organization:**

This is a two semester course. In Phys 431, we will cover the first 6 chapters of the Griffiths’ book, which develops mathematical techniques and describes Electric and Magnetic fields in space and in matter. In Physics 432, we will cover the remaining chapters of the book, which describes the unification of Electric and Magnetic phenomena that was accomplished by Maxwell and applies the unified theory of time varying fields to the description of moving charges, electromagnetic waves, radiation phenomena, and the relativistic description of E&M.

Incidentally, because Maxwell did not have the modern formulation of vector calculus at his disposal, Maxwell’s E & M was very difficult to understand and very few did. Oliver Heaviside was particularly important in developing the formulation of the theory that we use today.

**Homework:**

Homework will be assigned at approximately two week intervals. It will be graded and will count as approximately 25% of the class grade. The homework will be graded by a graduate student grader.

It is very important that you work diligently on the homework and not only because it counts for much of your grade in the class. The notation and structure of field theory is elegant and compact and greatly aids in understanding the coupling of electric and magnetic fields, but it takes practice to learn how to reduce the equations to a form useful in applications. At various points in the course, we will develop formalisms that apply to electrostatics, magnetostatics, electrical circuits, optics, and the radiation of charged particles. Each of these is the foundation of a separate technical field, with its own set of mathematical methods. In the homework problems, you will find your way to the starting points for some of these special methods, but of course will not be able to explore them in depth.

**Tests:**

There will be a one hour midterm test covering Chapters 1-3 of the book and a final exam covering Chapters 1-6. On the final exam, 1/3 of the exam will be devoted to the first half of the course and 2/3 to the second half. The midterm will count 30% of the course grade and the final exam will count as 45%. I will grade the exam papers.

The midterm exam will be given in early October (probably Oct 7 or 12) and the final exam is scheduled for Dec. 7.