SYLLABUS

Electricity and Magnetism
Physics 432
Spring, 2007; TR 8:10-9:25; Phys 306

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

Instructor:
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Why Study Electricity and Magnetism?  This intermediate level course in classical electro-magnetism is appropriately described as 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, during the first semester:

• You learned Electrostatics and Magnetostatics at the level that it is most often used in experimental physics and practical applications.
• You got your first serious introduction to the field concepts that are used almost universally in more advanced theory.
• You were introduced to vector calculus, which is the natural mathematical language needed to describe fields.

In addition, E&M provides a critically important bridge to many other topics in physics.  Most of the these topics are covered in the second semester.

• The study of time dependent fields in the second semester couples electric and magnetic phenomena and completes the formalism of Electrodynamics as developed by Maxwell.  This formalism is then applied to optical and radiation phenomena in subsequent chapters.
• 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 combine Coulomb’s law for the field of a static charge with the relativistic transformations to generate the equations for both electricity and magnetism.  This relativistic formulation completes the materials treated in this course.  This treatment makes extensive use of the potential formalism of E&M that is also further developed in the second semester.
• 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.  Again, the quantum extension of electrodynamics uses potentials rather than force fields to accomplish the quantization.
Course Organization: This is a two semester course. In Phys 431, we covered the first 6 chapters of the Griffiths’ book, which described electrostatic and magnetostatic 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 the applications of electrodynamics to electromagnetic waves, radiation phenomena, and relativity.

Homework: Homework will be assigned at approximately two week intervals. It will be graded and will count as 25% of the class grade.

Tests: There will be a one hour midterm test covering Chapters 7-9 of the book and a final exam covering Chapter’s 7-12. 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 25% of the course grade and the final exam will count as 50%.