Physics 3201

Fall 2013, last updated August 28, 2013

Lecture: Tu, Th at 9:30-10:45
MSB, room 407
Web page: **http://www.phys.uconn.edu/~eyler/phys3201/**

Course Instructor: Edward Eyler, Physics P325
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Office hour: Wednesday, 3:00-4:00 PM. I am frequently available at other times in my office or in my laboratories, rooms P301 and P302S.

Course Assistant: Limited support will be available from John Mangeri, Physics P218

Initial Assignment: Read Sections 1.1, 1.2, and 2.1 of Griffiths. Problem Set 1 will be posted on the course website by August 29, and is due on Thursday, September 5.

Honors Students: By special arrangement: an extra problem will be assigned each week, and discussed during a biweekly meeting (probably on Fridays at 1 PM).

Description:

Physics 3201 is the first semester of a two-semester introduction to electromagnetism at an intermediate level, and includes electrostatics, magnetostatics, and basic electrodynamics. It is directed primarily to physics and engineering students in their third or later years of physics study, and a sound mathematical background will be assumed. However, I will include a fairly extensive discussion of vector differential calculus and other selected mathematical methods needed for the course.

Texts and references:

The required text is *Introduction to Electrodynamics, 4th Ed.,* by Griffiths. The course will follow this text fairly closely, although with variations to make the start of the course less purely mathematical, and to include a few important topics overlooked by Griffiths. Lecture notes will be posted when they depart significantly from the text. Chapters 1-6 will be covered this semester.

For those of you that want a little quick help with vector calculus, you might want to take a look at *div grad curl and all that, 4th Ed.,* by H.M. Schey, or at the more recent *A Student's Guide to Maxwell's Equations* by Daniel Fletch. Both provide quick informal treatments.

A singularly useful source for background reading or review on basic electromagnetism is *Electricity and Magnetism, 3rd Ed.*, by Purcell and Morin. This is a newly updated version that uses SI units throughout. Although nominally an introductory text, Purcell's discussion is so carefully crafted, with so much physical insight, that it probably provides the best coverage anywhere of the fundamental principles of the subject.

There are several other texts at approximately the same level as Griffiths. An interesting book that assumes just a little more mathematical background than Griffiths is *Classical*

Electrodynamics, 2nd Ed., by Hans C. Ohanian (Jones & Bartlett, 2006). It offers an alternative viewpoint, as well as excellent coverage of several topics omitted by Griffiths. The Ohanian book is quite unusual in its explicit treatment of electromagnetism as a relativistically invariant theory, right from the start. Another classic text at this level is *Classical Electromagnetic Radiation* by Mark A. Heald and Jerry B. Marion (3rd Ed., reprinted by Dover (cheap!) in 2012). Be cautioned that Ohanian and Heald both use cgs units, so you will find some 4π's in unexpected places and some expected ε_0's missing in others. This problem is not shared by *Maxwell's Equations and the Principles of Electromagnetism* by Richard Fitzpatrick (Infinity Science Press, 2008). It offers a different alternative approach, by introducing the full time-dependent Maxwell's equations almost immediately, and only then turning to discussions of electrostatics and magnetostatics.

If your interests are more applied, consider *Foundations of Electromagnetic Theory* by Reitz, Milford, and Christy, which is a bit more formally organized than the Griffiths text and makes much closer connections with real-world engineering phenomena.

Finally, the classic graduate-level text is *Classical Electrodynamics 3rd Ed.*, by J.D. Jackson. It is recommended only if you would like to see a more formal mathematical treatment of some of the advanced topics in the course.

Syllabus:

1. Organization, unit systems, and Vectors.
2. Coulomb's and Gauss' laws, vector differential operators.
3. Electrostatics I: Potentials; divergence and curl of the electric field.
4. Electrostatic energy; perfect conductors; capacitors.
5. Multipole expansions.
6. Electrostatics II: Laplace's equation in vacuum; numerical and transform methods.
7. Electrostatics III: Dielectrics.
8. Magnetism: Biot-Savart and Ampère's laws.
9. Divergence and curl of **B**; the magnetic vector potential **A**.
10. Magnetic materials.

Assignments and grading:

There will be problem sets on an approximately weekly basis. I am planning two hour examinations and a final exam. The course grades will be based 34% on the final exam, 23% on each hour exam, and 20% on the problem sets.

Regarding problem sets:

1. Please stay current! Late problem sets will ordinarily not be accepted.
2. We will only be able to grade two or three randomly selected problems each week, but full solutions will be posted on the web page, the day after each problem set is due.
3. Come by and ask questions. Also, feel free to collaborate with other students regarding methods for solving the problems. Don't, however, solve the entire problem collaboratively — the work you hand in should be your own. And *do not* make use of any information from pre-existing solutions, whether from Instructor's solution manuals, prior students, web resources, or any other source.