Syllabus for PHYS 407: Electromagnetic Theory

September 7, 2016

Instructor: Dr. Lynn Sparling
Office: PHYS 425, PH: 5-6231, Office hours: after class on Friday or by appointment.
Class meeting time/place: 10:00-10:50, MWF, PHYS Rm 201
Grader: Michael Wolfe **Course Assistant**: Gordon McDonnell
Text: Introduction to Electrodynamics, 3rd Ed., D. Griffiths.

1 Overview

Electromagnetism is at the heart of a diverse array of natural phenomena across spatial scales from atoms to galaxies. The mathematical description is heavily based on multivariable calculus and vector fields and so we will start with an intense review of the mathematical tools. The course will cover the standard material, including electrostatics and magnetostatics, solutions to Laplaces equation, electric and magnetic fields in matter, electrodynamics and Maxwells equations. I expect to cover most of Chapters 1-7 and parts of Ch. 8 and 9 in Griffiths; we will follow the text content fairly closely, although I will rearrange somewhat the order in which topics are covered and will add some additional material and applications to other areas of science and technology.

2 Math skills required for success in this class

I will assume that you are at least familiar with the basics of vector addition and multiplication, first and second order ordinary differential equations, complex numbers, waves, multivariable calculus and vector analysis. I will also assume that you have some programming skills, and know how to make plots of data or functions. Those without the necessary math prerequisites cannot enroll in this course. From previous experience, I know that most students will need to review these math fundamentals, so the course will begin with a week of *intense* math review. (We will review partial differential equations later in the course.) You will have a 1/2 hour quiz on this material before we begin electrostatics (Ch. 2 in Griffiths); this will give you feedback early in the course. If you fail the exam, you should consider dropping the class, or doing extra work to get up to speed.

3 Homework, Exams, Projects

3.1 Homework

Homework will be assigned on Mondays and collected the following Monday. No late assignments will be accepted without prior permission. While only a subset of assigned problems will be graded in detail, you should make sure you understand all the problems, as the exams will be based partly on them. While much can be learned from collaborating on homework, you should struggle with the material by yourself first because you will learn much better that way. Homework writeups must be entirely your own work. This is an advanced course, so I expect homework solutions and exam work to be neatly written, which means in an expository style, with explanations of what you are doing. The main results (not every single intermediate algebraic step) and any result that is subsequently used or referred to should be numbered. Each problem must be started on a new page, with your name, assignment number and problem number (e.g. HW1.3). This will made grading much easier. Each HW assignment will have its own Bb discussion forum. Please post questions there, since many of you will likely have the same question. Michael and I will check it

frequently. Feel free to answer or comment on other students' questions, and please point out any typos or errors that you find.

3.2 Exams

Math Assessment Quiz (20 min.): Monday, 9/12

Exam I Lectures xx-xx Wed, 10/5
Exam II: Lectures xx-xx Fri, 11/5
Final: Lectures xx-xx TBA

Except for the first exam on 10/5, these dates are tentative and may change somewhat. The exact content to be covered on each exam will be announced before the exam.

3.3 Group project

There will be one group project, exact due date TBD, but it will be sometime in mid-November. Students will work together in groups of 4. You will be given a list of projects to choose from. More info later.

4 Grading

2 Midterm Exams: 40% Homework: 20% quizzes: 10% project: 5% Final: 25%
$A :> 87\%$ $B : 75-87\%$ $C : 60-75\%$ $D : 45-60\%$ $F :< 45\%$

5 Lecture content, relevant chapers/sections in Griffiths, schedule

A complete schedule of material to be covered each week will be posted separately. The schedule for the first few weeks is listed below, the relevant Chapters from Griffiths are also listed.

1. Week 1,2 (W 8/31 - F9/9 (4 lectures) [Ch. 1]: . Multivariable and Vector Calculus Review
   Materials: Vector Calc handout, Index notation primer. HW1 is due on Monday, 9/12.

   These first lectures will be an *intensive* review of vector calculus, the mathematical foundation for this course. Read the handout, which should help with the HW. You should attend at least one of the extra review sessions:
   Friday, 9/2, 4-6pm, room 401
   Wed, 9/7, 6-8pm, room 401
   Extra review/HW session: Fri, 9/9, 12-3pm, room 226

2. Week 3 (9-/12 - 9/19), [Ch. 2]: Electrostatics I
   Mon 9/12: Vector calc quiz/assessment

6 BlackBoard

Check the PHYS 407 Bb site a couple of times a day for updates. Please post questions about homework, lectures or exams on the relevant forums on Discussion Board, they will be monitored frequently. Each HW assignment will have its own forum where ideas can be exchanged and questions posted. Submissions of useful scripts or LaTeX tips that others might find useful are encouraged. Homework assignments will be posted in the Assignments section, and check the Course Materials section for other class materials. The Class Blog menu item is for general questions, comments, ideas, anything you find that's interesting and you want to share. Nerdy physics jokes (esp. E&M) are strongly encouraged.

7 Using LaTeX for homework and projects

Technical work often involves complicated mathematical expressions that are cumbersome to write, and must be rewritten if they have errors. You can greatly reduce the workload for homework assignments by using LaTeX (but it's optional). Text documents have file extension .tex, which is a simple text format; LaTeX typesets this file and produces a .pdf file.The format for assignments is the 407 HW LaTeX template (HW407.txt) which will be posted in the course materials section on Bb. There will be a separate LaTeX discussion forum on Bb where you can ask formatting questions or post any useful tips you find.

The project in this course will be typeset using LaTeX. It's a good idea to learn how to use it; most journals will accept LaTeX documents, and offer "style files" that automatically format the document in the style of a given journal. There are LOTS of resources available online for LaTeX users; good sources for LaTeX are the Comprehensive Tex Archive Network (ctan.org) and the worldwide Tex Users Group (tug.org).

The LaTeX distribution for both MAC and Windows can be downloaded (free) at ctan.org. For Windows, you can download the package proTex. It includes MikTex as the engine, and TeXstudio as the text editor. Some use the Texmaker package on Windows.

Some other links are:

http://miktex.org/
http://www.howtotex.com/howto/installing-latex-on-windows/

The engine for MAC is TexShop. This is part of the MacTex package and can also be downloaded at http://tug.org/mactex/ or http://www.macupdate.com/app/mac/12104/texshop.

Useful tutorial LaTeX stuff (I'll post some good ones on Bb in the Course Materials section):

http://www.andy-roberts.net/misc/latex/index.html
http://ctan.tug.org/tex-archive/info/lshort/english/lshort.pdf
http://www.howtotex.com/packages/beautiful-matlab-figures-in-latex/

8 Learning Goals

I will update this syllabus with specific learning goals for each week. The general learning goal for the first few lectures is to become proficient with Vector Calculus.

Academic integrity: It is university policy for me to remind you about academic integrity. Cheating on exams is absolutely forbidden and at the very least will result in a zero on the exam and possibly an "F" in the course, which can become part of your permanent record. You are at a point in your physics careers where Im sure you realize that you can fool some of the people all of the time, and all of the people some of the time, but you cant cheat your way through physics.