Physics 3320 Syllabus – Fall 2014

Lectures: MWF 1 PM in Physics G125 (starting with the 2nd lecture, Wed Aug 27)
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Office hrs: Tentative - Mon 4-5 PM, Tues (4-6) 11th floor for now, and see below.
Or by app't (just email!) *I enjoy visiting and talking with you about physics.*
Web page: www.colorado.edu/physics/phys3320, and also we have a D2L site.
The online syllabus contains more than you will find here. Check it often!

Physics 3320, *Principles of Electricity and Magnetism 2*, is the second semester of our two-semester sequence of junior-level classical electromagnetism. It uses the tools of vector calculus to understand dynamic properties of electromagnetic fields. The topics we will cover include non-static electric and magnetic fields, induction, the complete Maxwell equations, momentum and energy of electromagnetic fields, electromagnetic waves and waveguides, radiation, full potential treatment of non-static electromagnetic fields, and special relativistic aspects of electromagnetism. We have many learning goals in this course, which include content and mathematical skill mastery, high level problem-solving skills, physical sense-making, deepened conceptual understanding, communication skills, and connection to other courses and to the real world.

Required Prerequisites: Phys 3310 (E&M 1).
Required purchases:
1) J.D. Griffiths. *Introduction to Electromagnetism*, 3rd Edition (Prentice Hall; New Jersey; 1999). (4th edition is ok too, 2nd edition would work in a pinch)
Pedagogically excellent, this is my favorite undergrad textbook of them all.
2) "iClicker", available at the bookstore, will be used every lecture! (See web for details)
There will be copies of Griffiths on reserve at Gemmill Library along with several other good texts including the "Feynman Lectures in Physics", "Electromagnetism" (Pollack and Stump), and "A student's Guide to Maxwell's Equations" (Daniel Fleisch)

Reading *is an essential part of 3320!* Reading the text *before* class is very important. Lecture is to *clarify* your understanding, to help you make sense of the material. I will assume you have done required readings in advance! Griffiths is one of the best (and most readable) texts we know of - it *will* make a huge difference if you spend the time and effort to carefully read and follow the text.

Classroom Etiquette: Please turn off all cell phones and pagers when entering any classroom. Please do not throw vegetables at the instructor. Private chatter during lecture is very distracting, but it is perfectly OK to interrupt the lecture by yelling "Question!" Questions in lecture are always good, and are strongly encouraged!

Homework: there will be a homework due every Wed at the *start* of class. Late homework can't be accepted once solutions are posted - but, your lowest score will be dropped. Homework is exceedingly important for developing an understanding of the course material, not to mention building skills in complex physical and mathematical problem solving. They will require considerable time and personal effort this term!

Online Participation ("preflights") There will be a short online reading survey due every Mon at 10 AM. This is much quicker (and lower stress) than written homework. It may involve working through a derivation, or solving a puzzler to set up for a new topic. It also gives you a chance to review, provide feedback and ask questions. It is graded on effort/participation, not on correctness. We'll drop one or two of these. (We'll have *other* participation activities for extra credit – stay tuned). It's easy to forget this, coming after the weekend, make an effort to get to it every week!

<u>I strongly encourage collaboration</u>, an essential skill in science and engineering (and highly valued by employers!) Social interactions are critical to any scientists' success - most good ideas grow out of discussions with colleagues, and essentially all physicists work as part of a group. Find partners and work on homework together. However, it is also important that you OWN the material. I strongly suggest you start homework by yourself (and that means really making an extended effort on *every* problem). *Then* work with a group, and finally, finish up on your own - write up your own work, in your own way. There will also be time for peer discussion during classes - as you work together, try to help your partners get over confusions, listen to them, ask each other questions, critique, *teach each other.* You will learn a lot this way!
Note: *While collaboration is the rule in technical work, evaluations of individuals also play an important role. Exams will be done without help from others. For* all assignments, *the work you turn in must in the end be* <u>your own</u>*: in your own words, reflecting your own understanding.*
(If, at any time, for any reason, you feel disadvantaged or isolated, contact me and I can discretely try to help arrange study groups.)

<u>Help Sessions:</u> ***(Times listed at the top of the syllabus)*** Help sessions/office hours are to facilitate your learning. I encourage attendance - plan on working in small groups, my role is "learning coach". Sessions will be focused on homework, but we will *not* be explicitly telling anyone how to do the homework (how would *that* help you learn?) I strongly encourage you to *start all problems on your own*. If you come in "cold", the value of homework to you will be greatly reduced.

<u>Grading and exams:</u> Your course grade is determined by a combination of your performance on exams and homework, plus your participation in the weekly online preflights.

Exam 1	**Thurs Oct 2**, 7:30-9:30 PM	HUMN 150 (or, TBA)	16% of course grade
Exam 2	**Tues Nov 13** 7:30-9:30 PM	HUMN 150	18%
Final Exam	**Wed Dec 17,** 10:30 AM-1 PM	TBA (probably our class?)	30%
Homework	**Due Wed at start of class**		30%
Preflights	**Due Mon by 10 AM (!!)**		6%

Clickers and optional online participation**:** These activities are pure ***extra credit*****:** they REDUCE total midterm weights up to 10% of exam total (i.e. 6.4% of your grade). *See web page for details.*

Exams: There are no makeups. *You may not miss any exam* except for reasons beyond your control, approved by Prof. Pollock (usually a confirmed medical problem with written documentation.) In the unusual case of an (at most, single) excused absence from midterms, I'll use an average of your other exams. You may bring one side of a single sheet of 8.5 in. x 11 in. paper for each exam, with your own *handwritten* notes. Calculators with scientific notation are allowed and sometimes needed; no devices with wireless access are allowed. More details will be announced at the time of the midterm.

<u>Disabilities:</u> Students with disabilities, including non-visible disabilities, please let me know early in the semester (*first two weeks*) so that your academic needs may be appropriately met. You'll need to provide documentation to Disability Services Office in Willard 322 (303-492-8671)

<u>Syllabus:</u> See the online syllabus for more details, including the usual University policy details:
www.colorado.edu/physics/phys3320
Announcements about changes of any kind to the syllabus will be made in class, and (usually) posted on the web, and will *take precedence over this initial version*. You are responsible for what is said in class, whether or not you are in attendance.

<u>What we cover, and why:</u> Physics 3320 covers topics in electricity and magnetism (E&M). It is the 2nd semester of your *second* course in E&M (Physics 1120 was the first), but the first course in a true field theory. Classical electrodynamics (in the form of Maxwell's equations) is one of the most successful physical theories that we presently have. While it is a classical theory (no quantum mechanical Uncertainty Principle here), its conflicts with Newtonian mechanics motivated Einstein's development of Special Relativity. Thus, classical E&M is the first relativistically correct field theory. Also, Maxwell's unification of electricity with magnetism (at first viewed as separate phenomena) was the first and grandest example of unification of forces in physics.

For these reasons, along with the sheer mathematical elegance and completeness of the theory, and its extraordinary (uncanny!) agreement with experiment, electromagnetism is an inspiration for the creation of other physical theories including quantum mechanics and quantum field theory, and indeed much of contemporary physics. Further, classical E&M is at the root of a huge number of *practical* applications. Most of the phenomena of everyday experience, sights, smells, texture, etc. arise from a balance of electromagnetic interactions and quantum mechanics. E&M is essential in understanding the physics behind electric power generation, electronics, optics, communications, (and on, and on!) We *view* the universe around us primarily via the electromagnetic radiation. Clearly, to understand the physical world, we need to understand electricity and magnetism!

Comment on preparation: Physics 3320 covers some material you have seen before (Many of the topics stem from Phys 1120 material or from Phys 3310) but at a higher level of conceptual and mathematical sophistication.
Therefore you should expect:

- a large amount of material covered quickly.
- no recitations, and few examples covered in lecture. Most homework problems are not similar to examples from class.
- long, hard homework problems that usually cannot be completed by one individual alone.
- challenging exams.

Physics 3320 is a challenging, upper-division physics course. Unlike introductory courses, you are fully responsible for your own learning. In particular, you control the pace of the course by asking questions in class. Professors tend to speak quickly, and questions are important to slow down the lecture. This means that if you don't understand something, it is your responsibility to ask questions. Attending class and the homework help sessions gives you an opportunity to ask questions. We are here to help you as much as possible, but we need your questions to know what you don't understand.

Physics 3320 covers some of the most important physics and mathematical methods in the field. Your reward for the hard work and effort will be learning important and elegant material that you will use over and over as a physics major. Here is what we have experienced, and heard from other faculty teaching upper division physics in the past:

- most students reported spending a minimum of 10 hours per week on the homework (!!)
- students who didn't attend the homework help sessions often did poorly in the class.
- students reported learning a tremendous amount in this class.

The course topics that we will cover in Physics 3320 are among the greatest intellectual achievements of humans. Don't be surprised if you have to think hard and work hard to master the material.

How to succeed in this course: You can perform very well in this class if you follow this time-tested system:

1. Read the text sections before lecture. If you read first, it'll sink in faster during lecture.
2. Take detailed notes on your reading and *write down* questions so you can ask them in class.
3. Come to class and stay involved. Come to office hours with questions.
4. Start the homework early. Give yourself time to work and understand. No one is smart enough to do the homework in the last hours before class, and no one is smart enough to learn the material without working problems.
5. Work together. Do your own thinking, but talking to others is a great way to get unstuck.
6. Don't get behind. It's very hard to catch up.

<u>**Other references:**</u> There are many E&M texts out there. If you're having difficulties their different styles, perspectives, additional problems and examples may be very useful to you. Here are just a few suggestions:

G. Pollack and D. Stump, *Electromagnetism*, Addison Wesley 2002. This is at the level of Griffiths, and covers all the same material in much the same order. It is probably the second most commonly used book for courses like 3310-3320 across the country (after Griffiths). It's a little more mathematically focused (you'll find some derivations here that Griffiths is a little casual about), and the authors often do a nicer job motivating the physics, bringing in more examples and some historical references. It uses the same units (MKS metric) as Griffiths. (Pollack is no relation to me - apparently he spells his name wrong :-)

M. Heald and J. Marion, *Classical Electromagnetic Radiation*, 3rd edition, Prentice-Hall, 1999. This is also roughly at the level of Griffiths, and covers all the same material - although I would say a little more mathematically focused and terse. It uses cgs (Gaussian) units, which will make the formulas look just a little bit different (e.g, there's no ε_0 in Gauss' law!) It has been used at CU as the main text in some past semesters.

E. Purcell, *Electricity and Magnetism*, 2nd ed., McGraw-Hill, 1985. This is a great book for learning E&M. It was originally written in the 1960s for honors-level freshman courses (!) but its treatment of the material is nearly as sophisticated as Griffiths'. (MKS units, like Griffiths).

Feynman, Leighton, and Sands: "*The Feynman Lectures on Physics*, *part II*." (Part of a truly wonderful series of 3 "introductory" physics books, you should get a copy and read it!) Like Purcell, written in the '60s for freshmen at CalTech, it too covers much of the E&M from our 3310-3320 sequence. Feynman has amazing, brilliant insights into the physics and mathematics, this book can definitely help you make sense of the formalism we are learning! (MKS units)

And if that's not enough, a couple more thoughts -

Reitz, Milford, Christy, *Foundations of Electromagnetic Theory*, many editions (earlier ones by Reitz and Milford only). Another alternative textbook at a similar level to Griffiths. MKS units

J. D. Jackson, *Classical Electrodynamics*, any edition. Higher-level (this is a grad text), and very heavy on the math. This book is so universal in first-year graduate courses that the course is usually just called "Jackson" rather than "E&M". If you're going to graduate school, you might as well buy it now and save two years' book price inflation. (Gaussian units in old editions, but he switched to MKS in the 3rd edition).