Physics 3510 General Information, Fall 2015

Instructor: Dr. Daniel Schroeder

Office: SL208

E-mail: `dschroeder@weber.edu`

Phone: 801-626-6048 (works when I'm in my office, but email is better than voicemail for messages)

Course web page: `http://physics.weber.edu/schroeder/em/`

Office hours: MWF 10:30 – 11:20 am. I'll often be available at other times as well, though usually not on Tuesdays or Thursdays. My complete schedule is posted next to my office door. Feel free to make an appointment if you need to talk with me at a particular time.

Textbook: David J. Griffiths, *Introduction to Electrodynamics* (Pearson). I hope you like this book, which I and many others consider to be one of the best-written of all physics textbooks. The fourth (2012) edition is the latest, but you may also use the third (1999) edition if you can save money that way.

Course Outline

This course is all about the electric and magnetic fields, **E** and **B**, whose behavior is determined by Maxwell's equations. While it's easy to write the equations down, and you've seen them in a previous course, it takes a lot of practice to develop intuition for what the equations are telling us. And we can always learn more by applying the equations to new geometrical arrangements of charges, currents, conductors, insulators, and other materials.

1. **Vector calculus** (Chapter 1). The natural mathematical language of electrodynamics is multivariable calculus, including the various flavors of derivatives (gradient, divergence, curl) and integrals (line, surface, volume). This chapter also introduces the delta function, a convenient way of treating pointlike objects within the same mathematical framework used for continuous functions.

2. **Electrostatics** (Chapters 2–4). This is the special case where all of the source charges that create the fields are *at rest*. Then there is no magnetic field and the electric field has some special properties. These simplifications will help us get used to the mathematics and develop several powerful theoretical techniques.

3. **Magnetostatics** (Chapters 5–6). When charges are *moving* they also create magnetic fields, but here too we can simplify the description by assuming that the currents that create the fields are unchanging. Analogies with electrostatics will illuminate the ways in which magnetic fields are similar yet different.

4. **Electrodynamics** (Chapter 7 and Sections 8.1 and 10.1). Finally we turn to the general case in which the source charges and currents can move and change in arbitrary ways. Changing magnetic fields create circulating electric fields and vice-versa, as described by Maxwell's equations in their final form. Unfortunately, this course will end before we explore a full range of electrodynamics applications. But Physics 3540 will pick up where we leave off and cover the most important application: electromagnetic waves.

Goals of the Course

Besides helping you learn the facts about electric and magnetic fields, this course will help you further develop some broadly useful skills:

- Mathematical problem solving (especially with calculus and vectors);

- Building intuition for abstract and esoteric concepts;

- Visualizing things in three dimensions;

- Using a computer to speed up tedious calculations and visualize the results;

- Communicating what you have learned, especially in writing.

Even if you never make direct use of electromagnetic theory again, these skills will serve you well for the rest of your life.

But perhaps the most important goal of this course—and any other course in theoretical physics— is simply to help connect you with the fundamental laws that govern our universe. Knowing these fundamental laws may not always be of practical use, thanks to the complexity of nature and the many levels of structure between fundamental physics and the events that we care about. Even so, a grounding in basic physics teaches us that the universe is not completely arbitrary and uncertain: that if we work hard enough, we can actually understand a great deal of it. By helping us develop this attitude toward the universe, physics is not merely useful but also empowering and liberating.

Policies and Procedures

Class sessions will be spent on lecture, discussion, example problems, and occasional demonstrations. Reading assignments from your textbook are indicated on the class schedule, and I will expect you to read these assignments *before* class and come prepared to participate in discussion and ask questions. *Please feel free to interrupt with questions at any time.* Although I will not take attendance every day, I will certainly notice habitual absences or tardiness. A small portion of your grade will be based on class attendance and participation. (Your participation grade will *not* be based on how much knowledge you exhibit during class; asking questions can only *raise* your grade!)

Problem sets will be assigned roughly once a week, as indicated on the daily schedule, and will ordinarily be due (in my office or mailbox) by 1:30 p.m. The purpose of the problem sets is *not* to test you; rather they are an opportunity for you to practice and learn. I strongly encourage you to discuss the problem sets with your classmates, but only *after* you have made a good-faith attempt to solve each problem on your own. Discussions with classmates help you learn from each other, prevent careless errors, practice putting ideas into words, and work in an environment more like the "real world." You are also welcome to ask me for hints at any time. However, the work that you turn in must be entirely your own. This means that you may *not* look at anyone else's written solution (including any solutions published on the Internet or elsewhere) until after you have turned in your own. When you receive significant help from anyone on a particular problem, you must give that person credit in your written solution, indicating specifically what kind of help you received.

I will grade each problem set on a scale of 0 to 3, with the score based not only on your doing the right calculations but also on the completeness of your solutions and on whether they are clearly presented. Your solutions should be written so that any classmate could read and understand them. Solutions that are incomplete, illegible, or poorly organized will receive little or no credit, even if the answer is correct.

Late problem sets will not be accepted. However, your homework grade will be based on only the highest 10 (out of 11) problem set scores, so you may miss one problem set without penalty. This policy should give you enough flexibility to deal with most illnesses, family emergencies, term papers, unexpected romances, and the like; exceptions will be granted only in the case of very serious illness or other long-term crisis, and then only if you contact me as soon as possible.

Formal writing projects will be assigned four times during the semester (see schedule). For each of these projects you will type up a formal solution to a problem you have (or at least should have) already solved in a problem set. The purpose of these projects is to further clarify your thinking about these problems and to help develop your written communication skills. More details and guidance will be provided later. Each of these projects will be graded on a scale of 0 to 5 points, based on the quality of your written presentation including spelling, grammar, punctuation, sentence and paragraph structure, overall organization, logical clarity and correctness, skillful incorporation of mathematics into prose, and illustrations where appropriate. Writing projects turned in late will be marked down one point per school day.

Tests

We will have three **midterm tests**, given in the science testing center (SL 228). They will be closed-book, but you may use a calculator for doing arithmetic. The time limit on each test will be 90 minutes, and you will have approximately two days during which to take each test. After you have taken a midterm you may not discuss it (or otherwise communicate about it) *at all* with classmates who have not yet taken it (or who may not have taken it).

We will also have 110-minute **final exam**, similar in format but slightly longer and given in our regular classroom during our scheduled final exam time. The final will emphasize topics from after the third midterm but will also have some coverage of earlier material.

All tests will be graded according to the same critera used for problem sets (including clarity).

No make-up tests will be given without *advance* permission.

Grades will be computed according to the following weights:

Problems sets (highest 10 @3%)	30%
Formal writing projects (4 @5%)	20%
Three midterms @10%	30%
Final exam	15%
Attendance and participation	5%

Academic dishonesty, though rare, occasionally does occur in physics classes, so the following policies are necessary. You are responsible for understanding WSU's policies on academic ethics and honesty, as described in Section IV.D.2 of the Student Code (`weber.edu/ppm`, Section 6-22). A violation of these policies on any problem set or formal writing project will result in a zero grade for that item on the first occurrence and failure in the course thereafter. A violation of any sort on a test will result in automatic failure in the course. In serious cases, evidence of code violations may also be presented to the appropriate hearing committee for possible further sanctions.

In the event of a **campus emergency** (e.g., a power outage or unsafe weather conditions) that interrupts the schedule of this class, please check your email promptly for any special instructions. It is your responsibility to make sure I have your preferred email address.

Special notice: Any student requiring accommodations or services due to a disability must contact Services for Students with Disabilities (SSD) in room 181 of the Student Service Center. SSD can also arrange to provide course materials (including this syllabus) in alternative formats if necessary.