Physics 3510 General Information, Fall 2019

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Course web page: `http://physics.weber.edu/schroeder/em/` (not on Canvas!)

Office hours: MWThF 10:30–11:30, T 12:00–1:00. I'll often be available at other times as well, although usually not before 10:30 am. 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*. 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. Beware of low-quality "international" editions, which may be abridged and otherwise defective.

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 unfamiliar 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 Maxwell's equations 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 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, in-class exercises and quizzes, and occasional demonstrations. Reading assignments from your textbook are indicated on the class schedule, and I will expect you to prepare well enough 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 portion of your grade will be based on class attendence and participation.

Problem sets will be assigned roughly once a week, as indicated on the daily schedule. I will grade each problem set on a scale of 0 to 4, with the score based not only on your doing the right calculations but also on the completeness of your work and on whether it is clearly presented. Your solutions need not be formal or verbose, but 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.

Many of the assigned problems will be difficult, so here are some suggestions/rules on how to approach them:

- First, understand that a problem set is not a test! You are never expected to know how to work a problem immediately upon reading it. You'll need to spend some time thinking about it, writing out your thoughts, drawing tentative sketches, rereading your textbook, and so on. There is no substitute for this initial process of confronting the unknown—and nobody else can do it for you. You must therefore make a good-faith effort to solve each problem by yourself, before seeking any help.

- Often you will get stuck. Good! This is an opportunity for you to learn. But don't spend a long time spinning your wheels. Find someone to talk to—preferably a classmate who has also spent some time trying to work the problem. Discuss the problem out loud, perhaps in front of a marker board. If you're still stuck after 20 minutes, or if you can't find a classmate to talk to, then come and talk to me in my office, or, if all else fails, send me an email explaining the difficulty.
- Even if you think you've solved a problem correctly, it's a good idea to check answers with classmates (or with me), and to discuss the problem out loud, to solidify your understanding and iron out any remaining wrinkles.
- Although I strongly encourage you to discuss the problems with classmates, the work you turn in must be your own. This means you may never look at anyone else's written solution before turning in your own, and likewise you may not share your written solutions with anyone else who has not already turned in the problem set. In computer-assisted solutions, every keystroke must be your own (no copy-paste from classmates or any other sources).
- As a matter of professional ethics and courtesy, you should acknowledge any significant help you receive, by including a brief but specific note. For example: "Thanks to Emmy Noether for pointing out that in this scenario energy must be conserved."
- Nowadays many of us are accustomed to using Google to answer all of our questions. This is a fine way to settle a bet over which pitcher hit a home run in the 7th game of the 1967 World Series, but it's not an acceptable way to solve a physics homework problem. As you work the problem sets, you may use the internet as a reference to look up physical constants, word spellings, software documentation, and so on. You may *not* use it to seek any help that is specific to the problem you are trying to solve, or even that is specific to the physics topics that pertain to the problem. Trust me: the internet is not an efficient way to learn physics! If you have any doubt about what uses of the internet are and are not allowed in this course, please ask. Violations of this policy constitute academic dishonesty and will be treated as described below.

Many of the problem sets will include a short **writing exercise** of some type. These exercises will help you develop your written communication skills and give you a chance to think about some of the physics more deeply. In these writing exercises I expect you to use your best English, including correct spelling, punctuation, grammar, paragraph structure, and so on. Details will be provided in the assignments.

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 so on. Exceptions will be granted only in the case of long-term illness, military deployment, and the like, and then only if you contact me as soon as possible.

Tests

We will have three **midterm tests**, given in the Tracy Hall testing center (TY 101C). 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 a window of 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 criteria 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 @4%)	40%
Three midterms @10%	30%
Final exam	20%
Quizzes, attendance, etc.	10%

Academic dishonesty, though rare, occasionally does occur in physics classes, so the following policies are necessary. You are responsible for understanding the policies in this syllabus as well as 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 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.

The Student Code also contains multiple provisions that essentially require you to treat your fellow students with respect, both in and out of the classroom. Inappropriate behavior toward other students will not be tolerated and will be reported to the appropriate authorities for possible sanctions.

All written materials for this course, including quizzes and tests, are covered by copyright law and may not be reproduced, in printed or electronic form, without written permission.

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 WSU email promptly for any special instructions.

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.