

Physics 2210 Syllabus, Sp '11. Steven Pollock and Ana Maria Rey

Lectures: Tu/Th 5 PM (Switched to G125)
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Graders: TBA, see web.
Office hrs: Tentatively Tues (2-3), Wed (3-6) See web for locations, details and updates!
Or by app't (just email!) We all enjoy visiting and talking with you about physics.
Web page: www.colorado.edu/physics/phy2210
The online syllabus contains more than you will find here. Check it often!

Physics 2210 is the 1st semester of our 2-semester sequence of classical and mathematical physics, the foundation and building blocks of physics. We will build on concepts you've been exposed to in Phys 1110, but with more mathematical sophistication. This course also serves as an important bridge to prepare you with the problem solving skills that you will need for junior and senior level classes. We will cover Newton's Law's (including position and velocity dependent forces), Conservation laws (Energy and Potential), non-inertial reference frames, oscillation (including harmonic oscillators, and questions of stability) heat and gravitation. Mathematically, we will focus on curvilinear coordinates, complex numbers, the gradient operator, Fourier series, and ordinary and partial differential equations. 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: You *must* have completed PHYS 2170 (or 2130), and Calc III (either MATH 2400/APPM 2350). You should have a strong working knowledge of algebra, trig, calculus, Phys 1110, and Phys 1120. A co-requisite is a linear algebra class (APPM 2360 or MATH 3130)

Required purchases:

- 1) John Taylor, *Classical Mechanics* (University Science Books, 2005).
- 2) M. Boas, *Mathematical Methods in the Physical Sciences*, (3rd ed, Wiley, 2006)
- 3) "iClicker", available at the bookstore, will be used every lecture. (See web for details)

Note: Textbook info and errata: Taylor: www.uscibooks.com/taylor2.htm, Boas: tinyurl.com/333527w

If you have the 2nd ed of Boas, a comparison/difference file is available on our website.

There will be copies of the texts in the Math/Physics library.

Reading is an essential part of 2210! Reading *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 the required readings in advance! Taylor is an excellent text - it *will* make a huge difference if you spend the time and effort to carefully read and follow the text. Boas will likely be a reference book you can use for the rest of your career.

Written homework: is due every Thursday at the *start* of class. Late homework can't be accepted (your lowest score will be dropped) Homework is crucial for developing an understanding of course material, not to mention building skills in physical and mathematical problem solving. They will require considerable time and personal effort this term!

Online homework ("preflights"): is due every Tuesday morning (10 AM). This will be much quicker (and lower stress) than the written homeworks, it may involve working through a derivation, or solving a puzzler to set up for the coming week's topic. It also gives you a chance to provide feedback and ask questions. It will be graded only on effort/participation, not on "correctness". (We will also have an "in-class participation" activity for everyone - see the web for details).

We strongly encourage collaboration, an essential skill in science and engineering (and highly valued by employers!) Social interactions are critical to scientists' success - most good ideas grow out of discussions with colleagues; essentially all scientists work as part of a group. Find partners and work together. However, it is also important that you OWN the material. Limit yourself to verbal help; don't ever take written information from others (don't take written notes when you talk to others) This will ensure that you think things through independently after you get help. If you do well on homework and poorly on exams, you are probably getting too much help. No credit will be given for a correct answer, unless accompanied by a complete and correct derivation. The point is not to find the answer, but to find out how to *construct* the answer. There will be time for peer discussion during classes: 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!

The primary rule of classroom etiquette is "be cool". It is perfectly OK to interrupt the lecture by yelling "Question!" Questions in lecture are always good, and are strongly encouraged!

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 your own: in your own words, reflecting your own understanding.*

(If you ever feel disadvantaged or isolated, contact us! We can discretely try to help arrange study groups).

Help Sessions: Help sessions/office hours are to facilitate learning. Please come - plan on working in small groups; our role will be as learning coaches. We will *not* explicitly show how to do the problems (how would *that* help you learn?) *Start all problems on your own first.* If you come to help sessions cold, the value of homework to you will be greatly reduced. If you wait until Wed to start, you're not giving yourself time to learn the problem-solving skills you need.

Grading and exams: Your course grade is largely determined by a combination of your performance on exams and homework. There will be some extra credit for in-class and online participation (which basically "unweights" the exams - see web for more details.)

Exam 1	Feb 10 (Thurs)	16% of course grade
Exam 2	Mar 17 (Thurs)	18%
Final Exam	Tu, May 3, 7:30 PM- 10 PM	30%
Homework	Due Thurs at start of class	30%
Preflights and in-class participation	Preflights due Tues by 10 AM (!)	6%

Clickers and 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 more details.*

Exams: There are no makeups. *You may not miss any exam* except for reasons beyond your control, approved by Prof. Pollock or Rey (usually a medical crisis with written documentation.) 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. More details will be announced near the midterm- see web.

Disabilities: Students with disabilities, including non-visible disabilities, please let us 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)

Syllabus: See the online syllabus for more details, including issues of religious observances, honor code, etc: www.colorado.edu/physics/phys2210

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 version*. You are responsible for what is said in class, whether or not you are in attendance.

(The rest is for the website:)

What we cover, and why: Physics 2210 is your *second* course in classical mechanics (following Physics 1110). We will cover roughly the first five chapters of Taylor's text (plus, perhaps, Ch 9. Phys 3210 continues with more advanced topics in this book), and related portions of Boas, largely Chapters 2, 4, 7 and 8.

Classical mechanics is a general framework rather than a description of a particular physical system. It describes and explains motion of objects (and groups of objects), subject to forces. It forms the *basis* for essentially all of modern physics - of course, Quantum Mechanics ultimately is required too, to extend the domain of applicability. But, Quantum mechanics nevertheless *builds* on classical mechanics. Classical mechanics lies at the heart of a huge variety of technology and natural phenomena. The mathematics we learn in this course is a natural extension of the calculus and algebra you already know, and will be used in some form in almost every formal scientific application you will likely encounter. The tools and topics we cover in this course set the stage for applications in such diverse fields as engineering, planetary and atmospheric sciences, fluid mechanics, and thermodynamics. Classical mechanics is an extraordinarily practical branch of physics - until the advent of computers it was hard to apply to most realistic systems, but today it is commonplace to calculate nonlinear phenomena, and extraordinarily complex models, building on the fundamentals we will cover this term. Classical mechanics is one of the oldest branches of physics, but it is still very much alive today, particularly in the domains of mechanical and civil engineering, fluid mechanics, statistical mechanics, and chaos theory. And, in the words of John Taylor, it provides "a wonderful opportunity" to learn a variety of mathematical techniques used throughout physics!

Comment on preparation: Physics 2210 is a challenging, upper-division physics course. Unlike earlier courses, you are fully responsible for your own learning. Physics 2210 covers much material you have not seen before, at a higher level of conceptual and mathematical sophistication than you may have encountered in a physics class so far. Therefore you should expect:

- a large amount of material covered quickly.
- no mandatory 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.

YOU control the pace of the course by asking questions in class. We 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 2210 covers some of the most fundamental 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 (and beyond!). Here is what we have experienced:

- 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.

How to succeed in this course: The topics in Phys 2210 are among the greatest intellectual achievements of humans. Don't be surprised if you have to think and work hard to master this!

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.

Other references: There are many introductory classical mechanics 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:

- Thornton and Marion- "*Classical Dynamics of Particles and Systems*" (This is often the text for Phys 2210, it is a similar level, perhaps a little more mathematically focused, than Taylor. This would be an excellent first choice to go to if you feel confused about a topic)
- Hamill, "*Intermediate Dynamics*" (Just another text very much at the level of ours)
- Kleppner and Kolenkow, "*Introduction to Mechanics*". This is like an "honors freshman" level mechanics textbook, beautifully written.

For other math references:

- Arfken and Weber "*Mathematical Methods for Physicists*" (a little bit higher level than Boas)
- S. Lea, "*Mathematics for Physicists*"

Other books of possible interest for this course:

Feynman, Leighton, and Sands: "*The Feynman Lectures on Physics, part I.*" (Part of a truly wonderful series of 3 "introductory" physics books, you should get a copy and read it!)