CorwinLab

PHYSICS 351: FOUNDATIONS OF PHYSICS II

Instructor
Prof Eric Corwin
374 Willamette Hall
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Lectures
MWTThF 1:00 – 1:50 pm, 110 Willamette Hall

Office hours
Thursday 11:00 am – 12:00 pm, or by appointment, 374 Willamette Hall
You are strongly encouraged to come to office hours, either with course-related questions, or just to chat.

In addition, we will hold required in-class office hours on Thursdays. This is an opportunity to ask questions and work with one another.

Teaching Assistants (GTF)
Andrew Hammond ahammond7@uoregon.edu office hours Wednesday 2-3pm, Willamette 374

Roger Smith rsmith13@uoregon.edu office hours Thursday 10-11am, Willamette 242

Textbook
Most of the text for the course will be provided on Blackboard

Topics
It is not only not right, it is not even wrong.
Attributed to Wolfgang Pauli

I like relativity and quantum theories
because I don't understand them
and they make me feel as if space shifted about
like a swan that
can't settle,
refusing to sit still and be measured;
and as if the atom were an impulsive thing
always changing its mind.

'Relativity', D.H Laurence

Week 1: How to answer problems that you don't know how to answer. To this point in your scientific career you have mainly been concerned with learning how to solve a class of problems and then applying that solution to well defined questions. But how do you solve a problem when you don't have any formulae to start with?

Weeks 2-5: Special Relativity. Special Relativity teaches us that much of our intuitive understanding of the world is slightly wrong. Special Relativity is predicated on two simple postulates: 1) There is no privileged "rest" frame; every non-accelarting frame of reference is equivalent, and 2) The speed of light is constant everywhere. From these two postulates we will derive the mechanics of special relativity. Along the way we will lay to rest numerous seeming paradoxes.

Weeks 6-10: Quantum Mechanics. We will start with the unintentional unraveling of classical physics set in motion by Planck's solution to the "ultra-violet catastrophe" and work through to a modern understanding of quantum mechanics. Along the way we will develop Schrödinger's famous wave equation and recast the Hamiltonian operator of classical physics in a quantum light. We will apply these tools to the task of understanding the behaviour of conjugate variables (position and momentum, time and energy, etc.) and thereby derive Heisenberg's uncertainty principle. We will also examine the behaviour of particles under the influence of various potentials (square well, harmonic, etc.) and derive scattering and tunnelling behaviours. Throughout the course we will comment on the interpretations of quantum mechanics and attempt to understand how to square our everyday world with the predictions of quantum mechanics.

More broadly, this course aims to assist you in your development as a scientist. We hope to demonstrate to you that physics is not a collection of facts and formulae, nor a series of disconnected topics, but rather a unified (but incomplete) approach towards understanding the world using critical and analytical thinking.
Question to start class

Each class will begin with a conceptual question, related in some way to the topics of study. These questions are intended to push you to integrate your knowledge and understanding of physics into a coherent whole. You will have about 5 minutes to try to puzzle things out for yourself and then another 5 minutes to try to convince your neighbors that you are right. Afterwards we will discuss as a class.

Homework

There will be weekly problem sets due on Mondays. Except by prior arrangement late homework will only be accepted until 24 hours after the deadline and will automatically lose 50% of its score.

Problem sets exist to aid you in understanding and reasoning about physics. I don't care much about the numerical answer. I care that you understand what you are doing and can articulate your thought-process. To this end, I will require that all problem set solutions be in the form of fully explained well-written English. Each question will be graded out of 15 points total, 10 points for scientific correctness of your answer and 5 points for the clarity and quality of your writing. This means that I expect a well developed logical argument and explanation of your solution. It should go without saying that correct grammar, punctuation, and spelling are required. An example of how to write a problem set solution in plain English can be found at <http://phasismid.uoregon.edu/wp-uploads/2013/01/HWExample.pdf>.

I understand that this is unusual and may chafe initially. However, I hope to convince you of the merits of this approach, which I believe will aid your understanding and better prepare you to become scientists.

No Laptops in Class

The use of laptops and phones in class is in general not allowed. Why? Several studies, plus past experience, show that students using laptops in class spend a great deal of time on non-class-related activities (facebook, games, …) and that these distractions negatively impact both learning and grades. This alone isn't a reason to ban laptops – you're responsible for your own performance in class. In addition, however, studies have shown that non-class-related laptop use distracts and impacts the learning of other students nearby. (E.g. Fried, C. B. Computers & Education 50, 906-914 (2008).) Plus, students have complained to me about the environment created by their classmates laptop use. Taking notes by hand, by the way, is more effective in cementing concepts in your mind. The only exceptions will be for people with documented medical needs; please see me if this is the case.

Homework groups
Students are **highly** encouraged to collaborate on homework, but reminded that the work you submit should be your own. I can almost guarantee that by working with others you will achieve a deeper understanding of physics and get a better grade in the course. If you get stuck on a problem, don’t spin your wheels for very long. It is useful to struggle for a while, but it is a waste of your time to stare at one problem for hours. Instead, talk to your problem set group or come to office hours.

**Course Objectives**

At the end of the course you will be expected to possess:

- Ability to apply principles and concepts to analyze problems.
- Experience with integration of concepts: analysis of complex problems cutting across multiple domains of physics.
- Knowledge of principles and concepts for special relativity and quantum mechanics.
- Ability to communicate physics concepts orally and in writing.

**Grading**

Final grades will be determined by a ranked combination of scores on homework, midterm(s), and a final. Your best performance will contribute 45%, middle 30%, lowest 25%. Your grade may be supplemented by your class participation as measured by engaging in the question to start class as well as asking and answering questions in class.

**Students with disabilities**

If there are aspects of the instruction or design of this course that result in barriers to your inclusion, please notify me as soon as possible. You are also welcome to contact Disability Services in 164 Oregon Hall, 346-1155.