Physics 351: Foundations of Physics II

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

**Instructor:** Eric Corwin <ecorwin@uoregon.edu>

**Eric's Office Hours:** TBD

**GTF Contact:** Joel Doss <jdoss@uoregon.edu>, Saul Sun <wenqians@uoregon.edu>

**GTF Office Hours:** TBD

**Lectures:** TuTh 12-1:50pm, 204 Tykeson

**Special Note Regarding Online Instruction:**

This is an unprecedented and awful time. I think that it is a moral imperative for us all to help take care of one another. I want you to know that, beyond my role as an instructor and evaluator, I'm here to support you in your learning and your education. Physics 35X is a difficult sequence and I know that all of you are taking it because you are committed to learning and care about physics. I intend to teach and evaluate you in that spirit.

**Discord Server:**

To facilitate informal discussion, etc., I've created a discord server for this class. You can join it with this link <https://discord.gg/t7qfdfjmHZ>.
Topics and Aims:

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.

**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?

**Week 2: Introduction to Scientific Programming with Python.**

**Weeks 3-6: 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-accelerating 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 7-10: 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.

**Textbook**

Most of the text for the course will be provided on Canvas.

**Assignments and Grading**
Colloquium Report (5%): One of the goals of this course is to guide you on your journey to becoming independent scientists. To this end it is important to expose yourself to contemporary research by going to the departmental colloquia or other similar talks. For this assignment you will write a short report, around 400-800 words, about any one of this term’s Physics Colloquia. More details can be found in the specific assignment.

Homework (30%): Completing and understanding homework is perhaps the most important part of the course (though not the easiest to assess). You’ll learn a lot by doing and thinking about the homework problems. There will be homework assignments every week. You are encouraged to discuss the questions with others and to work with others, but of course, the work you submit should be your own. Solutions will be posted – study these. No late homework will be accepted.

In this course we’ll employ a novel grading scheme for homework, designed to encourage you to fully understand any mistakes that you may have made and to internalize the problem solving methods. Completed problem sets will be turned in to canvas by the start of class on Monday as pdfs. There are many tools available for scanning handwritten work to pdfs. Among them, https://support.apple.com/en-us/HT210336 (Links to an external site.), https://support.google.com/drive/answer/3145835?co=GENIE.Platform%3DAndroid&hl=en (Links to an external site.), etc. Turned in work will be graded for completeness, which will count for 1/3 of the grade. Solutions will be posted on canvas and students will then self grade their own homeworks against the solution set and turn in the graded homeworks at the beginning of the next class on Wednesdays as a pdf. The act of grading the homework will be worth 1/3 of the grade and the self-assigned grade will constitute the final 1/3 of the total grade for the homework.

Quizzes (45%): There will be short quizzes nearly every week on Wednesday. We’ll use these to assess understanding of key points without the heavy weight of an exam. In addition to relying on all of your knowledge of physics, the quizzes will revisit homework problems from the preceding problem set. Each student’s lowest quiz score will be dropped from the overall total. There won’t be any make-up quizzes; if you miss one, this will be the quiz dropped from your overall grade calculation.

Final Project or Final Exam (20%): In lieu of a final exam we may do a final project consisting of either 1) a literature review report on a topic of your choice relating to the course or 2) a simulational project in which you write a high quality numerical simulation and data analysis on a topic of your choice relating to the course.

Overall Grade: A=[90,100); B=[80,90); C=[70,80); D=[60,70); F=[0,60]. Note that these are minimum guarantees, which I may (likely) choose to loosen.
Absences: Students with a serious and well-documented reason for missing an assignment or exam should contact me. If you contact me in advance of the missed work then it will be much more likely that we can work out a favorable agreement. Please see the descriptions of quizzes and reading quizzes for policies on missing any of those.

How to Do Well in the Course

Plan ahead and start early! This applies to everything in the course - homework, reading assignments, and general studying. It will be crucial to keep up with the course and not fall behind; later topics build on earlier ones. Homework assignments, especially, will require considerable time spent thinking – the majority of your learning will come from this.

Make use of resources! If you have questions about lectures, assignments, readings, or other matters, come to office hours with questions! Also, we encourage communication by email or canvas (but won't promise to answer outside of normal work hours).

Sleep! Many studies show that sleeping helps memory and understanding.

Student Conduct and Academic Integrity:

Mutual respect in class is paramount. Academic Misconduct, as defined in the Student Conduct Code <https://studentlife.uoregon.edu/conductLinks to an external site.>, including cheating, fabrication, facilitating academic dishonesty, and plagiarism, devalues the reputation of our institution, its faculty, its students, and the degrees we offer. Moreover, academic misconduct is particularly unfair for the students who do their work with integrity and honor. Violations of the student conduct code result in the incident being included on your student conduct record and can result in a failing grade on any course work related to the violation or a failing grade in the course. Every effort will be made in this class to deter dishonesty through classroom procedures. Suspected academic dishonesty will be reported.

Campus Resources to Support Learning

Tutoring and Academic Engagement Center <https://engage.uoregon.edu/services/Links to an external site.> Drop-in math and writing support in addition to tutoring, study skills support, and Class Encore. Located in the 4th Floor Knight Library (541) 346-3226, engage@uoregon.edu.
Counseling Center Call anytime to speak with a therapist who can provide support and connect you with resources. Located on the 2nd Floor of the Health Center (541)346-3227.

Accessible Education Center The University of Oregon is working to create inclusive learning environments. The instructor believes strongly in creating inclusive learning environments. If there are aspects of the instruction or design of this course that result in barriers to your participation, please notify us as soon as possible. You are also encouraged to contact the Accessible Education Center. If you are not a student with a documented disability, but you would like for us to know about class issues that will impact your ability to learn, we encourage you to come visit during office hours so that we can strategize how you can get the most out of this course. Located on the 1st Floor of Oregon Hall (541) 346-1155, uoaec@uoregon.edu.

Center for Multicultural Academic Excellence (CMAE) Their mission is to promote student retention and persistence for historically underrepresented and underserved populations. We develop and implement programs and services that support retention, academic excellence, and success at the UO and beyond. We reaffirm our commitment to all students, including undocumented and tuition equity students. Located on the 1st Floor of Oregon Hall (541) 346-3479, cmae@uoregon.edu.

The UO Access Shuttle An on-campus ride service provided at no cost to students with conditions that limit mobility. More information and a sign-up form can be found on the parking & transportation department website:
https://parking.uoregon.edu/content/access-shuttleLinks to an external site.