University of Maryland
Department of Physics

Spring 2021 Prof. Steven Anlage Physics 401

Title:
Physics 401: Quantum Physics I: Introduces some quantum phenomena leading to wave-particle duality. Schrödinger theory for bound states and scattering in one dimension. One-particle Schrödinger equation and the hydrogen atom. The first semester of the two-term sequence on introduction to quantum physics for physics majors. This is a 4-credit course.

Prerequisite:
PHYS371 and PHYS373. A good working knowledge of integral calculus, linear algebra and differential equations is essential.

Instructor:
Prof. Steven Anlage, Room 1363 (Physics/QMC). You can find the QMC either by 1) going through the blue door labeled "Quantum Materials Center" in the basement of the physics building, or 2) entering QMC from the plaza between the Math and Physics buildings.
Phone: 5-7321, e-mail: anlage@umd.edu, web site: anlage.umd.edu

Schedule:
Three lectures weekly, M..... 10:00am - 11:50am, WF..... 11:00am - 11:50am which includes a 1 hour discussion /lecture. All meetings will be live, online and synchronous.

Required Text:
David Griffiths and Darrell Schroeter, Introduction to Quantum Mechanics **3rd Edition** (Cambridge University Press, 2018) ISBN-13: 978-1107189638. Suggested for background reading: Alexandre Zagoskin, Quantum Theory: A Complete Introduction 1st Edition (Teach Yourself, 2015) ISBN-13: 978-1473602410.

Virtual, Live and Synchronous Classes:
The plan is to deliver this class in exactly the manner as is done when we meet in person. The lectures will take place *live* between 10:00 AM and 11:50 AM on Mondays and 11:00 AM and 11:50 AM on Wednesdays and Fridays, and will be recorded and posted on the ELMS web site for your convenience. Questions are encouraged during the lectures. All quizzes will take place during class hours. Both of the mid-term exams will be held during the class period. The final exam will be given during the 2-hour time period on 15 May allocated for this class. The office hours will not be recorded. Note that a high quality and consistent internet connection is required to take this class.

Lectures:
You will be responsible for material presented in lecture that is not in the book. If you miss a lecture you can check out the recorded lectures posted on ELMS and the open class web site.

Homework:
The homework assignments will be given on the (open) class website and on ELMS. The assignment will be due at the beginning of class on Fridays. Please upload your homework paper in a single **pdf format** (only) to ELMS. Homework turned in by any other means will not be counted. Two homework problems will be graded quantitatively (0-10) and the rest will be graded qualitatively (0-1-2). The choice of the two problems to grade quantitatively will be made *after* the homework is collected.

Doing the homework is a very important part of this course! Homework will be returned by the following week. Late homework will not be accepted. As compensation, the two lowest homework grades from the semester will be dropped.

Quizzes:
There will be quizzes in class, generally on Mondays, but not on any regular schedule. The quiz will cover topics in the homework assignment due the previous Friday, and should be considered as part of the homework assignment. The quiz will be taken on ELMS and open during the last 10 minutes or so of class on Monday. The quiz is CLOSED book, notes,

internet, etc. There will be no makeups for these quizzes! As compensation, the two lowest quiz scores from the semester will be dropped.

Exams:
There will be two "mid-term" exams and a final exam. You must be continuously on Zoom with your camera *on* for the entire duration of the exams. The exams are CLOSED book, notes, internet, etc., unless otherwise noted. All exams will count towards your final grade. Make-up exams (for any of the exams) must be requested well in advance of the exam; the reason for the absence must be documented and in accord with University policy (see p. 109 of https://catalogundergraduate.umd.edu/files/2017-2018-UGCatalog.pdf).

In grading, we are looking more at the reasoning that you use, rather than the final number you arrive at. So remember to carefully set up the problem on paper, even if you cannot see the way through to the solution.

The final exam is Saturday, May 15 from 8 to 10 AM.

Numerics
Developing a working knowledge of numerical techniques in the context of physics problem solving is an important skill. You are encouraged to solve problems using programs such as Mathematica and WolframAlpha. Note that a student version of Mathematica is available for download from TERPware: http://terpware.umd.edu/Windows/Title/1837 This course makes heavy use of integration and you are encouraged to solve these integrals by computer so that you can focus on higher level issues.

Final Grade:
Based *approximately* on homework (~25%), quizzes (~15%), mid-terms (~40%), and final (~20%).

Academic Dishonesty (cheating):
Academic dishonesty is a serious offense that may result in suspension or expulsion from the university. In addition to any other action taken, the normal sanction is a grade of "XF", denoting "failure due to academic dishonesty," and will normally be recorded on the transcript of the offending student. Note that general university course policies are posted at http://www.ugst.umd.edu/courserelatedpolicies.html.

Undergraduate Policies and Rights
Here is a link to the Office of Undergraduate Studies Course Policies for Undergraduates http://www.ugst.umd.edu/courserelatedpolicies.html

Office Hours
You are strongly encouraged to attend office hours to ask questions, discuss the homework problems, and talk about physics in general. The office hours will be held 4:00-5:30 PM on Thursdays, just before the homework is due. These Zoom sessions will not be recorded.

(Open) Class Web Site (containing lecture summaries):
http://www.physics.umd.edu/courses/Phys401/AnlageSpring21/

ELMS web site:
The ELMS web site will be used mainly to post homework, quiz and exam solutions. ELMS also has a record of your homework, quiz and exam scores (you should check that they are accurate). Note that the gradebook page is NOT an estimate of your grade, and should not be used that way, it is simply a record of the scoring for each assignment.

Tips For Doing Well In This Course:
1) Read the assignment in the book *before* and *after* the material is covered in lecture.
2) Freely ask questions in lecture, after lecture, and during office hours. Also discuss problems with your friends and classmates.
3) Work all of the homework questions and problems. You are allowed and encouraged to discuss homework with anyone you wish. However, in order to really learn, don't just copy solutions from somewhere or someone else; rather, work through them in detail yourself. Afterwards, make use of the solution sets, your TA's office hours, and me to make certain you understand all of the solutions. The quizzes are based on the homework and the exams will sometimes involve homework problems.

4) Seek help immediately if you do not understand the material or can't solve the problems. Help is available from your TA, and from me. Don't wait until just before the exams! If you are experiencing difficulties in keeping up with the academic demands of this course, contact the Learning Assistance Service (http://www.counseling.umd.edu/las/). Their educational counselors can help with time management, reading, note-taking and exam preparation skills.
5) Remember that you are responsible for material discussed in class, even if it does not appear in the textbook.

What Should You Learn in this Class?

Physics 401 will introduce you to the concepts and analytical skills required to understand quantum mechanics. The course is taught in the 'Schrodinger Picture,' which is relatively easy to grasp, but we will also delve into the abstract representation of quantum states as vectors in Hilbert space. Both of these perspectives are needed to go deeper into the subject and understand the unique and sometimes counter-intuitive world of quantum mechanics. Although we do not consider quantum information science in this class, the topics covered here are essential for understanding the rapidly growing field of quantum information science/technology.

Physics GRE

There is an emphasis on both historical aspects of quantum physics, as well as many general concepts from one-dimensional quantum mechanics on the Physics GRE exam. The textbooks by Krane or Tipler/Llewellyn or Taylor/Zafiratos/Dubson will be of great help in preparing for the historical aspects, while Griffiths is ideal for the analytical part of the exam. The more practice you have solving problems in quantum mechanics, the better you will do on the Physics GRE.