PHYS 500A (Graduate Quantum Mechanics)

Syllabus, Spring 2021

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Content:

This one-semester course is an introduction to quantum mechanics at the graduate level. One semester is hardly enough time to review the highlights of the quantum theory as it existed in the early 20th century, let alone to cover more modern developments. Most of your learning will take place on your own, in reading texts and solving problems. In the class meetings we will cover the following topics:

- From Stern-Gerlach to the postulates of quantum mechanics; linear algebra (5 lectures).
- Hamiltonian and time evolution (3 lectures).
- A landscape of quantum mechanical systems (3 lectures).
- Path integrals and Dirac charge quantization (2 lectures).
- Angular momentum and the rotation group (4 lectures).
- Hydrogen-like atoms (2 lectures).
- Approximate methods (3 lectures).
- Scattering (3 lectures).

There will be some other topics, like density matrices, which you will explore in Problem Sets.

Textbook and supplementary material:

1. The primary text for this course is Sakurai & Napolitano, *Modern Quantum Mechanics*.
2. Hitoshi Murayama has excellent lecture notes accompanying the Graduate Quantum Mechanics course Physics 221A at UC Berkeley. They are available at `http://hitoshi.berkeley.edu`.
3. I am also making my pdf Lecture Notes available. They can be found on the class Brightspace page. I will periodically update them throughout the semester.
4. There are many other books that you should use as resources in addition to S&N. I recommend Feynman & Hibbs, *Quantum Mechanics and Path Integrals*; Baym, *Lectures on Quantum Mechanics*; and Dirac, *The Principles of Quantum Mechanics*.

Course format:

Lectures:	Monday/Thursday 1100-1220, online.
Problem Sets:	Roughly every other week.
Final exam:	There will be a take-home exam during the Final Exam period, between April 15 and April 27.

Grades:

1. Final: 35%
2. Problem sets: 65%

General comments:

1. Problem sets will be given approximately once every two weeks. They are due no later than 1700 the day they are due.
2. I will return marked problem sets via email. However, for two problem sets, I will ask that you meet with me over Zoom for 15-20 minutes or so, to discuss that problem set. If you do not meet with me, you will not receive the marked problem set back, nor any credit for it. The purpose of these meetings is to give you the chance to learn how to summarize your results for another scientist, and to demonstrate that you really know the material.
3. The problem sets are *essential*. Physics is learned by doing, as you now know very well. Indeed most of your learning in this course will take place in solving problems. Do not expect to succeed in this course without putting in significant effort (on the order of $\gtrsim 10$ hours/week) on the assignments. I encourage you to collaborate with your fellow students, however, you should independently write up your assignments, both because you owe it to yourself to properly learn the material and in the interest of academic integrity. Further, when you write up your assignment, ensure that it presents a clear and concise argument, starting from the information given and working step by step to a conclusion, which, ideally, should be boxed so as to indicate that you have obtained the desired result. A tangled mess of formulas without explanation will receive zero credit.
4. I encourage you to write up your problem sets using LaTeX. It takes some time to get used to, but it is a worthy investment. To write and compile a pdf document in LaTeX, you will require a repository of TeX libraries as well as an editor. There are plenty of free repositories and editors out there; if you are paying for one, something is wrong.

   If you use Windows, I would suggest you use MiKTeX (available at https://miktex.org/download). The download available there will give you most of the libraries you need as well as the editor *TeXWorks*. If you are a Mac user, I would suggest MacTeX (available at http://www.tug.org/mactex/). The download includes libraries as well as the editor *TeXShop*, which I use daily.
5. Please take advantage of my office hours.
6. You may use Mathematica or the computational software of your choice to assist solving problems on problem sets or on the exam. However, if you do so, please write up an explanation of what your code does, in clear English, to accompany the code. You may not however quote a result from Wikipedia or any online source.
7. The Final exam will be take-home. My standard approach is to give 24 hours for take-home exams. It should take about 8-10 hours to complete. The exam will be open-book, however you may not use the Internet to look for solutionsor work together on problems. You *may* email me with questions of any sort, for example to clarify a question or to ask if there is a mistake in a problem, etc.

Unpleasantries:

1. There are not many students enrolled in this class, and so it will be easy to detect when one student plagiarizes another's solution. Plagiarism of another student's solutions, or the copying of a solution off the internet, will result in an automatic zero score on the assignment for everyone involved as well as trigger an investigation with the Chair. See `https://www.uvic.ca/students/academics/academic-integrity/index.php` for further detail.
2. Barring medical or family emergency, late assignments will *not* be accepted.