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University of Victoria
Department of Physics and Astronomy
Physics 323 - Quantum Mechanics I
Fall 2022 Syllabus SUMMARY

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General Information

Instructor: Travis Martin
Email: `travismartin@uvic.ca`
Office Hours: TBA, office hours will be on Zoom
Course Webpage: http://bright.uvic.ca

Lecture Schedule: Mondays and Thursdays from 10:00am-11:30am in ECS108

Quick Reference Info:

- Get a textbook and use it. Quantum Mechanics by McIntyre or Introduction to Quantum Mechanics by Griffiths. Success in quantum mechanics means reading every page, not just skimming through the book for equations.

- You must complete all labs and pass the lab portion of the course to pass the course. You must achieve acceptably well on the final exam to pass the course.

- There will be two midterms in the course: October 14 and November 10. There will also be an in-class quiz that is within September, once we have covered the initial topic of the course.

- There will be 8 assignments (no assignment due in weeks with a midterm) worth 25% of your grade, total. Labs are worth 10%, midterms are worth 25%, and final is worth 40%.

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Prerequisites:

PHYS215 and MATH204. The course is structured assuming you are taking MATH342 at the same time as PHYS323, thus MATH342 is either a prerequisite or co-requisite course. It is STRONGLY recommended that you have completed PHYS280 before taking this class.

Class Materials:

- **Textbook** - A textbook is strongly recommended for this course. The textbook for this course is for reference material; no homework questions will be assigned from the textbook. *Quantum Mechanics* by McIntyre is the superior of the offerings for this level of quantum mechanics. *Introduction to Quantum Mechanics* by Griffiths is an acceptable textbook, but misses out on a lot of the formality. We will be using linear algebra more than Griffiths does. *Modern Quantum Mechanics* by Sakurai is an excellent textbook, but will likely be too formal in its approach - it is a good text for preparation for grad school.

Labs:

The lab schedule can be found at `http://www.uvic.ca/science/physics/current/undergraduate/timetables/index.php`.

Some notes regarding minimum requirements for passing this course:

- **You must complete all labs and receive an overall passing grade in the lab component.**
- **You must achieve a minimum acceptable grade on the final exam.** The minimum acceptable grade will not be set above 40%.

Pandemic Notice

While classes have returned to campus, the pandemic is not yet over. Widespread infection rates and variant transmissions mean that the pandemic should still be taken very seriously. Students and faculty may express a wide range of differing opinions and emotions towards how to best navigate the risks and challenges of the pandemic. As a class, we need to manage these opinions in a productive way.

To help facilitate this, I have the following expectations for how students will behave in my class:

1. Students are required to follow all relevant provincial, university and faculty instructions regarding distancing, handwashing, masks and other similar issues.

2. Students are not permitted to attend any in-person course component (lecture/lab) if ill; students exhibiting any cold or flu-like symptoms will be asked and required to leave and go home. Accommodations for missed material due to illness can be discussed via email. All lectures have been video recorded, so all material can be reviewed without the need to attend lectures.

3. While masks are not mandatory, it can significantly reduce the spread of illness by asymptomatic individuals. I strongly encourage the continued use of masks.

4. Students are requested to get vaccinated in a timely manner if not already vaccinated.

Please also take note of the following:

- Students will not be permitted to enter my personal space before, during or after the lecture. If you have questions, you may ask respectfully from a distance.

- Office hours will be held on Zoom rather than in-person. Students will not be permitted to attend my office for any reason at any point in time during the semester.

- Students who miss more than 40% of any component of the course (illness lasting longer than 1 month) will be encouraged to complete a Request For Academic Concession to drop the course. Accommodations can only cover short term ailments. It is in your best interest to withdraw from a course if you miss that much material.

- If I am sick for any reason, I will inform the class and I will not be attending the lectures for the duration of my illness. In such cases, students will be expected to watch the video recorded lectures. Class will not stop simply because the instructor is sick.

Course Overview

The end goal of this course is to provide all of the necessary tools and methods for understanding the full quantum mechanical hydrogen wavefunction. A rough outline of the course is below, however the order may be changed in response to the challenges of online learning.

1. Quantum Math

    (a) Introduction (Motivation for Quantum Mechanics)

    (b) Statistics (Expectation values, Variance, Standard Deviation)

    (c) Linear Algebra (Vectors, Inner Products, Matrix Multiplication, Eigenvalues, Eigenvectors, Basis, Change of Basis)

    (d) Hilbert Space (Inner Product/Function Space, Connection to Linear Algebra)

    In-Class Quiz

2. Quantized Systems

    (a) Quantum Mechanics (Hidden Variables, Copenhagen, Statistical Interpretation)

    (b) Schroedinger's Equation (Derivation, Operators, Free Particle Wavefunction)

    (c) Functional Example - Infinite Square Well (Quantized States, Calculations in QM)

    (d) Time Evolution (Stationary States)

    (e) Functional Example - Finite Square Well

    (f) Functional Example - Harmonic Oscillator

    (g) Functional Example - Scattering and Tunnelling

    MIDTERM 1

3. Angular Momentum

    (a) Spin & The Stern-Gerlach Experiment

    (b) Angular Momentum

    (c) Addition of Angular Momentum, Mixed States, Clebsch-Gordon

    MIDTERM 2

4. Hydrogen Atom

    (a) Shroedinger's Equation in Spherical Coordinates

    (b) Radial Equation

    (c) Angular Equation

    (d) Combining All Components

5. Fermions and Bosons - Exchange Forces

    FINAL EXAM

Grading

If the application of this scheme would result in grades that are judged by the instructor to be inconsistent with the University's grading descriptions (`https://web.uvic.ca/calendar2014/FACS/UnIn/UARe/Grad.html`), then the instructor will assign percentages consistent with them.

Assignments: 25%

There will be 8 content-related assignments throughout the semester and 4 computational assignments. Assignments will be due at the start of class on the provided due date. You will be graded on the best 7 of 8 of the content assignments, and best 3 of 4 computational assignments. Each assignment carries the same weight.

Assignment Policy: You are allowed to work together with other students on assignments, so long as your work and your solutions are your own.

Neatness Policy: You are expected to treat your assignments with respect. Assignments that are disorganized or difficult to read will receive reduced marks at the marker's discretion.

Laboratory Activities: 10%

The labs with this class are assigned due to logistical reasons, rather than pedagogical reasons. It is department policy that you must pass the labs in order to pass this course.

Midterm Exams: 25%

There will be two midterms in this course. The first one will cover the math review, Schroedinger's Equation and 1D position dependent potentials. The second one will include any 1D potentials that were not included in the first midterm, as well as spin and angular momentum.

Final Exam: 40%

The final exam will be comprehensive, in that it will require knowledge of all of the material of the course.

Accommodations:

Accommodations can be made for missed exams/assignments due to illness or other severe affliction, as well as conflicts with classes and religious observances. Accommodations will also be made for issues documented through the CAL.

If you miss an exam or assignment, I expect you to contact me as soon as possible. If you anticipate missing a course requirement, you must contact me a reasonable time in advance. If an emergency occurs during a test, please talk to me. I can't help if I don't know about the problem.

University Regulations on Academic Integrity

These regulations are reproduced from `http://web.uvic.ca/calendar2011/FACS/UnIn/UARe/PoAcI.html`. For full information, including procedures for dealing with academic integrity infringement, see the webpage linked above.

Academic integrity requires commitment to the values of honesty, trust, fairness, respect, and responsibility. Any action that contravenes this standard, including misrepresentation, falsification or deception, undermines the intention and worth of scholarly work and violates the fundamental academic rights of members of our community.

Several types of academic integrity violations are covered in brief below.

Plagiarism

A student commits plagiarism when he or she:

- submits the work of another person as original work
- gives inadequate attribution to an author or creator whose work is incorporated into the student's work, including failing to indicate clearly the inclusion of another individual's work
- paraphrases material from a source without sufficient acknowledgement as described above

Students who are in doubt as to what constitutes plagiarism in a particular instance should consult their course instructor.

Falsifying Material Subject to Academic Evaluation

Falsifying materials subject to academic evaluation includes, but is not limited to:

- fraudulently manipulating laboratory processes, electronic data or research data in order to achieve desired results
- using work prepared by someone else (e.g., commercially prepared essays) and submitting it as one's own
- citing a source from which material was not obtained
- using a quoted reference from a non-original source while implying reference to the original source
- submitting false records, information or data, in writing or orally

Cheating on Assignments, Tests/Quizzes and Examinations

Cheating includes, but is not limited to:

- copying the answers or other work of another person
- sharing information or answers when doing take-home assignments, tests and examinations except where the instructor has authorized collaborative work
- having in an examination or test any materials or equipment other than those authorized by the examiners impersonating a candidate on an examination or test, or being assigned the results of such impersonation
- *assisting others to engage in conduct that is considered cheating*