PHYB54-2016: Introduction to Quantum Mechanics

Course Instructor:

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Course Meeting Times

Lectures: 2 sessions / week with 1 hour / session

Tutorial: 1 sessions / week with 1 hour / session

Office hours: Tuesday 13.00-14.00 and Friday 11.00-12.00 or by appointment

Textbook and References

David McIntyre, "Quantum Mechanics: A Paradigms Approach", 1st Edition. Pearson, ISBN-13: 978-0321765796.

References:

1. J. S. Townsend, "A Modern Approach to Quantum Mechanics", 2nd ed. ISBN 978-1-891389-78-8.
2. J. J. Sakurai and J. Napolitano, "Modern Quantum Mechanics", 2nd ed. ISBN 10: 0-8053-8291-7
3. D. J. Griffiths, "Introduction to Quantum Mechanics," 2nd Edition, (ISBN 0-13-111892-7)
4. Stephen T. Thornton and Andrew Rex, Modern Physics for Scientists and Engineers, 4th edition. *This book is useful for material related to the failures of classical physics lead to the Quantum Mechanics.*

In addition, there are many other textbooks on Quantum Physics and I would advise students to take a look at as many as possible as they all deal with topics slightly differently. An explanation that resonates with one person may not resonate with another, so the usefulness of reading about the same material presented in a variety of formats cannot be overstated.

Course Objectives

The course introduces the basic concepts of Quantum Physics and Quantum Mechanics starting with the experimental basis and the properties of the wave function. Schrödinger's equation will be introduced with some applications in one dimension. Topics include Stern-Gerlach effect; harmonic oscillator; uncertainty principle; interference packets; scattering and tunnelling in one-dimension.

Overview of the course:

- *Introduction: The failures of classical physics lead to the Quantum Mechanical way of thinking about nature at the microscopic level. We shall condense the essence of key empirical evidence stemming from the Stern-Gerlach experiment and from a gedanken electron-diffraction experiment which provide the simplest quantum mechanical system to study.*
- *The language of Quantum Mechanics (QM): Dirac notation — bras, kets, operators, matrix elements, etc.*

- *The postulates of Quantum Mechanics: Probability amplitudes, probabilities, mean values, the measurement process, the "uncertainty principle, and time evolution of quantum systems.*
- *Spin 1/2 and other two-level systems are essential to understand the foundation of QM. The systems to be considered display the beauty and practical implications of Quantum Mechanics. This is achieved with a minimum of mathematical complications (Linear Algebra), which is a great advantage of the two-level systems).*
- *The harmonic oscillator in Quantum Mechanics, solved by operator techniques, represents an excellent application. Other applications will also be considered.*

Elementary aspects of wave mechanics are assumed to be part of your background.

Academic Expectations: Collaboration

Adhering to high standards of academic integrity is an important part of your undergraduate experience. The standards are obvious when it comes to exams. Collaboration, such as working with others to conceptualize a problem, define approaches to the solution, or debug code, is often a gray area, and faculty in different courses may have different approaches to this issue.

In this course, discussion is allowed as long as it is identified. Plagiarism, such as copying someone else's solution or COMPUTER code if required, is not allowed. The write-ups must always be your own. Modifying someone else's Assignment or code to make it your "own" is unacceptable. In case of doubt, consult the course instructor.

If you choose to collaborate with other students on the homework problems, indicate their names and the nature of your joint work. Ensure that your collaborator does the same on his/her assignment. A useful discussion of these issues may be found at http://www.utsc.utoronto.ca/~vpdean/academic_integrity.html.

Assignments

- There will be 5 to 6 sets of problems.
- There will be two midterm Tests held as decided by the Registrar.
- There will be a comprehensive final exam during finals week.

Problem Set Policy

Submission Checklist

1. Write up the problem and submit the answers in complete form.
    a. For an answer to be complete, you must explain the method you used to find the solution including the equations needed and explain the setup from the code.
    b. You also must include the solutions that the code generated with the appropriate comments about what these solutions indicate about the question posed.
2. If it is a Mathematica problem, submit the code that generates the answer and the due date is the same of the Assignment. It is your responsibility to make sure it has been gone through.
3. Each homework problem must be on a separate sheet of paper. If you need more than one sheet you should staple them together.

4. Turn paper copies in before class starts on the due date. No late work will be graded. If it is submitted the same day after the lecture, a penalty of 50% will be applied.
5. When collaborating, be sure to write the names of those you discuss with on the top of your homework.
    a. Collaboration is not sharing code files or copying someone's answers.
    b. Collaboration is asking questions to help clarify your own difficulties with the problem set.

Note: (In case computer programs are used like Mathematica or MATLAB)
In case some problem sets require the use of computers. Programming with Mathematica (MATLAB) is not an end in itself but a means to investigate more complex phenomena using visual, analytic and numerical methods. The Mathematica (MATLAB) code itself is not an adequate solution to the problem; you must interpret your results and answer the questions posed. You should approach the problem with the goal to understand and explain the physical phenomena investigated and the behavior of the system for variations of the parameters.

Grading *(Tentative and will discussed with students)*

ACTIVITIES	PERCENTAGES
Problem sets	25%
Midterm tests	30%
Final exam	45%

Attendance and participation is highly encouraged for both tutorials and lectures since we believe it will assist you to better understand the material covered.

The tentative calendar below provides information about the Topics covered in this course. This schedule follows the textbook ""Quantum Mechanics: A Paradigms Approach"," by David McIntyre. However, you may use other books that cover the same topics.

CHAPTER #	TOPICS	
Chapter-1	Introduction: Failures of Classical Physics & Stern-Gerlach Experiments	Week-1 & 2
Chapter-2	Operators And Measurement	Week- 3 & 4
Chapter-3	Schrödinger Time Evolution	Week-5 & 6

CHAPTER #	TOPICS	
Chapter-5	Quantized Energies: Particle in a Box	Week-7 & 8
Chapter-6	Unbound States	Week-9 & 10
Chapter-9	Harmonic Oscillator	Week-11

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Access*ability* Services at UTSC as early as possible in the term. The Access*ability* Services http://www.utsc.utoronto.ca/~ability/ will determine reasonable accommodations for this course.

GOOD LUCK