Ph 503 Quantum Mechanics, IIT Gn

Instructor: B. Prasanna Venkatesh

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Office: AB 6/ 315B
Lecture Days and Time: **Monday 10:05-11:00; Wednesday 09:05-10:00; Thursday 10:05 -11:00**
Tutorial: **Thursday 14:05-15:00**
Lecture Hall: 7/105
TA: Mr. Rahul Shastri, shastri.rahul@iitgn.ac.in
TA Office Hours: **Friday 17:00-18:00**
Course Website: Quantum 503

Course Description

This is a first, graduate level course on Quantum Mechanics. The objective of the course is to provide a solid understanding of Quantum Mechanics by an exposition of the basic mathematical formalism, fundamental concepts and important manifestations of Quantum behaviour. We will assume the student has had a first brush with Quantum Mechanics to the extent that they are familiar with the concept of a wave-function and the solution of Schrödinger equation for some simple one dimensional potentials.

Sources

The course will mainly be based on the book "Modern Quantum Mechanics" by J. J. Sakurai. Lecture notes will be provided for all the material covered and other sources occasionally used in the course would be:

- Non-Relativistic Quantum Mechanics, R. R. Puri (abbreviated below as: PQM)
- Mathematical Physics by V. Balakrishnan

Prerequisites

Prerequisites: Ph 101 (QM)/MSE 310/Instructor's Consent

Course Curriculum

Aug-Oct (Before Mid-Semester Break)

1. **Introduction to Quantum Mechanics** - focusing on double slit problem and Stern-Gerlach Experiment
2. **Mathematical Foundation of Quantum Mechanics** - Basic Linear Algebra
3. **Fundamental Concepts of Quantum Mechanics** - Dirac Notation, Matrix Representation, Measurements/Observables and Uncertainty Relations, Position-Momentum and Translation, Wavefunctions in Position and Momentum Space, Comparison of Classical vs Quantum Mechanics
4. **Quantum Dynamics**: Time evolution and the Schrödinger Equation, Schrödinger vs Heisenberg Picture, Simple Harmonic Oscillator, Schrödinger Wave Equation, Revisit of Simple 1-D problems
5. **Angular Momentum 1**: Rotations and Angular Momentum Commutation Relations, Spin 1/2 Systems and Finite Rotations, SO(3), SU(2) and Euler Roations

Oct-Dec (Post Mid-Semester Break)

1. **Angular Momentum 2**: Eigenvalues and Eigenstates of Angular Momentum, Orbital Angular Momentum, Revisit of Hydrogen Atom, Addition of Angular Momenta
2. **Symmetry in Quantum Mechanics**: Symmetries, Conservation Laws, and Degeneracies, Discrete Symmetries, Parity or Space Inversion
3. **Approximation Methods**: Time Independent Perturbation Theory (Nondegenerate and Degenerate Case and Examples, Variational Methods

Course Assessment

Home Assignments 4-5: 20 %
Announced Quiz 2: 2 X 10%
Surprise Quiz 1: 15%
Mid-Semester Examination: 20 %
End-Semester Examination: 25 %

Self-learning mode

You have a choice of learning the course with or without help of the instructors. If you choose to learn with the help of the instructors, you must be REGULAR in lectures and actively participate. If a student is found absent in more than 3 classes during the first 3 weeks, or, more than 6 classes during the first 5 weeks can be declared to be in the “self-learning mode". Those on self-learning mode will be free to attend lectures, BUT a. Their name will be removed from the attendance sheet, and b. Their homework, quizzes and mid-semester exam will not be graded

Attendance

Regular attendance is highly encouraged though it will not be enforced by taking attendance during class. Quizzes (both Announced and Surprise) will not be rescheduled (unless pre-arranged due to unavoidable reasons).

Tutorial

We will have tutorial sessions every week on Thursday. I will try my best to release the set of problems for each week's tutorial on the weekend before. In addition, each week I am also happy to solve problems that you bring to the tutorials. I encourage you to continuously try to solve problems.

Academic Integrity

Violations in academic integrity (cheating, plagiarizing, etc.) will result in no credit for the assignment, course failure and/or referral for disciplinary action.