Course Handout Part-II

18th January 2021

Course Number : ***PHY F242***

Course Title : ***QUANTUM MECHANICS - I***

Instructor-in-charge: ***Niladri Sarkar***

Objective and Scope of the Course:

Quantum Mechanics-I is an introduction to the mechanics of atomic and sub-atomic systems. The course is roughly divided into two parts. The first part (module 1 to 5) deal with the rudiments of wave mechanics and apply the same to some simple systems that will help clarify the novelty of quantum mechanical concepts. The second part (module 6 and 7) will then elaborate on the formal structure of quantum mechanics that will lay strong foundations for the advanced courses.

Text and reference books :

1. Quantum Mechanics by B H Bransden and C J Joachain (BJ) 2nd Edition Pearson Education
2. Introductory Quantum Mechanics by Richard L Liboff (RL) 4th Edition Pearson Education
3. Introduction to Quantum Mechanics by David J Griffiths (DG) 2nd Edition Pearson Education
4. Principles of Quantum Mechanics by R. Shankar Second Edition Springer

Note : The organization of the course are mainly followed from BJ, however the students are highly suggested to consult RL, DG and RS as well.

Module No.	Topics to be Covered	Ref. (BJ)	Learning Outcome
1. The Wave Function	L1-L4 : Wave-particle Duality, Interpretation of the Wavefunction	2.1 – 2.3	Realization the meaning of Wavefunction
2. Wave packets	L5-L7 : Real and Momentum Space Wavefunctions	2.4	Understanding the Application of Fourier Analysis which permits to express an arbitrary wavefunction as a superposition of Harmonic Waves.
3. The Heisenberg	L8-L10 : Uncertainty Relation for Momentum	2.5	Understanding of the Mathematical Properties of the Waves that Describe

Uncertainty Principle	and Energy and time, Expectation Values, Momentum and Position as Operators, Measurements in Quantum Mechanics		Quantum-Mechanical Particles.
4. The Schrodinger Equation	L10 - L20: The time-dependent Schrodinger equation, The Ehrenfest Theorem, Stationary States,	3.1-3.9	Understanding the Time-dependent and Time-Independent Schrodinger Equation
5. One-Dimensional Examples	L20 - L30 : Free Particle, The Potential Step, The Potential Barrier, Infinite Square Well, Linear Harmonic Oscillator, The Periodic Potential	4.1-4.8	Understanding of the Applications of Time-Independent Schrodinger Equation
6. The Formalism of Quantum Mechanics	L30 - L38 : Axiomatic Formulations , Schrodinger and Heisenberg Pictures	5.1 – 5.8.	Students should be enough prepared/motivated to understand abstract language/ advanced topics of quantum mechanics
7. The Factorization Method	L38 - L42 : The Harmonic Oscillator, Eigenvectors and Eigenvalue of a General Hamiltonian.	Class notes from various sources	Students will be learning to solve eigenvalue equations by means of a general and elegant operator method.

Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue	Nature of Component
1	Mid Term Test	90 mins.	30		Closed Book
2	Tutorials/Assignments	20 mins. for each tut test	30		Closed Book

3	Comprehensive Examination	3 hours.	40		Open/Closed Book

Notices: Notices/assignements/solutions etc. will be displayed *only on Nalanda.*

Make-up Policy: No Make-up for tutorial tests. Make up for regular tests will be given only to genuine cases (obviously), *i.e.*(i) Serious Sickness (ii) out-of-station with prior *intimation to* / *permission from* the IC.

Instructor-in-Charge

PHY F242