BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI-HYDERABAD CAMPUS
SECOND SEMESTER 2022-2023
COURSE HANDOUT- (QM I)

Date: 16.01.2023

Course No. **: PHY F242**
Course Title **: Quantum Mechanics I**
Instructor-in-Charge **: Asrarul Haque**
Instructor **: Asrarul Haque**

Course Description: Origin of the quantum theory - black body radiation, photoelectric effect, Compton scattering, electron diffraction, Bohr model of hydrogen atom,Frank-Hertz experiment, Bohr-Sommerfeld quantization condition; notion of wave function, statistical interpretation of the wave function, issues of normalization, the Heisenberg uncertainty relation; Schrodinger equation, stationary states and time independent Schrodinger equation, energy eigenvalues and eigenfunctions, one-dimensional problems – potential wells, potential barriers, the harmonic oscillator; Hilbert space formalism – state vectors, Dirac's bra-ket notation, observables as Hermitian operators, eigenvalues and eigenstates of Hermitian operators, the measurement postulate, Three dimensional problems- Particle in a three-dimensional Box, The Schrodinger equation in spherical polar coordinates, Angular momentum and spherical harmonics, The hydrogen atom.

Scope & Objectives:

The course on QM I aims to

- provide a thorough basic understanding of the fundamental principles of quantum physics,
- furnish insight in the microscopic structure of matter and
- develop an ability to employ the principles of quantum mechanics to solve a variety of simple quantum systems and

Text Book:

T1: Principles of Quantum Mechanics, R. Shankar

Reference Books:

R1: Modern Quantum Mechanics by J J Sakurai, **R2:** Quantum Physics (2nd. Edition), Stephen Gasiorowicz, **R3:** Introductory Quantum Mechanics L. Liboff, **R4:** Quantum Mechanics (Vol1) , Cohen-Tanudji

Course Plan

Lecture	Learning Objectives	Topics to be covered	Reference

Number			Chapter/ Section
1-5	The wave function	The statistical interpretation, Normalization condition, Probability density and current	5.3 (T1), 2.8(R3)
6-8	The uncertainty principle	Superposition of plane waves, The uncertainty principle	9.2 - 9.4 (T1)
9-11	Postulates of quantum theory	Postulates of quantum mechanics and its implications	4.1-4.2 (T1)
12-15	Time–Dependent Schrödinger equation	The Schrödinger equation, The Ehrenfest Theorem, The continuity equation for the probability density	4.3(T1), 3.4-3.5(R3)
16-18	Time-Independent Schrödinger equation	Stationary states, Boundary and continuity conditions, degeneracy, Orthogonality of eigen functions, parity	1.8, 4.2, 4.3,11.4 (T1)
19-28	One-dimensional problems	The free particle, The infinite square well, The finite square well,The potential step, The potential barrier, The delta function potential, The harmonic oscillator	5.1,5.2,5.4,7 .1-7.3 (T1)
29-32	Formalism	Hilbert space, state vectors, Dirac's bra-ket notation	Chapter 1 (T1)
33-40	Three dimensional problems	Particle in a three-dimensional Box, The Schrodinger equation in spherical polar coordinates, Angular momentum and spherical harmonics, The hydrogen atom	10.2, 12.4-12.6, 13.1-13.3 (T1)

Evaluation Scheme:

EC No.	***Evaluation scheme***	***Duration***	***Weightage (%)***	***Date, Time***	***Nature of component***
1	Quiz(zes)	50 min	25		Open book
3	Mid semester exam.	90 min	35	15/03 9.30 - 11.00AM	Closed book
4	Comprehensive Exam.	180 min	40	12/05 FN	Closed Book

- **Notices:** Notices for the course will be displayed on **Physics Group** notice board or/and uploaded on **CMS**.

- **Make-up Policy: Very strict** to **genuine cases only** i.e.

  (i) Sickness leading to hospitalization. (No make up for stomach-ache, diarrhea, vomiting, head-ache unless seriousness is verified by medical test.)

(ii) Out of station with **prior intimation** & **permission**.

Academic Honesty and Integrity Policy:

Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-Charge

PHY F242