**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI-HYDERABAD CAMPUS**
**FIRST SEMESTER 2020-2021**
**COURSE HANDOUT- (QM I)**

*Date: 17.08.2020*

***Course No.*** **: PHY F242**
***Course Title*** **: Quantum Mechanics I**
***Instructor-in-Charge*** **: Subhash Karbelkar**
***Instructor*** **: Subhash Karbelkar**

**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 eigen-functions, 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

**Text Book:**

**T1:** Introduction to Quantum Mechanics (Second edition) by D J Griffiths, LPE, Pearson

**Reference Books:**

**R1:** Modern Quantum Mechanics by J J Sakurai, **R2:** Quantum Physics (2nd. Edition), Stephen Gasiorowicz, **R3:** Principles of Quantum Mechanics, R Shankar

**Course Plan**

| Number of lectures | Learning Objectives | Topics to be covered | Text Book Section/s |
|---|---|---|---|
| 3 | The Schroedinger equation | The Schroedinger equation and statistical interpretation of wavefunction, | 1.1 to 1.2 |
| 3 | continued | Probability and continuity equation for it | 1.3-1.4 |

| | | | |
|---|---|---|---|
| 2 | Uncertainty principle | Momentum and uncertainty principle | 1.5-1.6 |
| 3 | Time independent Schroedinger equation | Stationary states, Continuity (or otherwise) conditions, one dimensional piecewise constant potentials: delta function potential | 2.1-2.6 (2.3 listed below) |
| 3 | continued | infinite and finite square well potentials, | 2.6 |
| 4 | The harmonic oscillator | The harmonic oscillator | 2.3 |
| 5 | Formalism | Hilbert space, observables, Hermitian operators | 3.1-3.3 |
| 4 | Generalized statistical interpretation | Generalized statistical interpretation, the uncertainty principle, Dirac notation | 3.4-3.6 |
| 5 | Spherically symmetric potentials | Schroedinger equation in spherical coordinates | 4.1 |
| 3 | The Hydrogen atom | The hydrogen atom | 4.2 |
| 7 | Angular momentum | Commutation relations, eigenvalues and eigen functions | 4.3 |

Evaluation Scheme:

| ***EC No.*** | ***Evaluation scheme*** | ***Duration*** (minutes) | ***Weightage (%)*** | ***Date, Time*** | ***Nature*** |
|---|---|---|---|---|---|
| **1** | TEST 1 | 30 | 15 | September 10 –September 20 $ | OB |
| **2** | TEST 2 | 30 | 15 | October 09 – October 20 $ | OB |
| **3** | TEST 3 | 30 | 15 | November 10 – November 20 $ | OB |
| **4** | TUT TESTS/QUIZES/ASSIGNMENTS | | 30 | Evenly spaced $ | OB |
| **5** | Comprehensive examination | 120 | 25 | As announced in the Timetable | OB |

**$:During scheduled class hour**

**First four listed components, with the exception of assignments if any, will be conducted during scheduled class hour.**

- **Notices:** Notices for the course will be uploaded only on **CMS**.
- All submissions to be sent by email to snkarbelkar@hyderabad.bits-pilani.ac.in with subject line QM1 component name your name. please see details in CMS.
- For doubts please connect with whatsapp 9649604370
- **All components are Open book.**
- **Make-up Policy: Very strict** to **genuine cases only** i.e. No make up for tut tests.
  **(i) Sickness leading to hospitalization**. (No make up for stomach-ache, diarrhea, vomiting, head-ache unless seriousness is verified by medical test. )
  **(ii) prior intimation** & **permission**.

**(iii)** request for granting make up must reach me on or before the actual time of the concerned component; please send email snkarbelkar@gmail.com stating reason/s and the earliest date make up can be conducted. Attach pictures of documentary proof in support of such request.

- **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***