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**SECOND SEMESTER 2023-2024**

# Course Handout Part II

Date: 09-01-2024

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No.* : PHY F242

## Course Title : Quantum Mechanics - I

## Instructor-in-Charge : AravindaRaghavan

**Scope and Objective of the Course:**In this course, we travel to atomic scales from macroscopic scales where our intuition developed through observing macroscopic phenomenon explained through classical theories of particles and waves fail. The course has three (unequal) parts. The first part concerns the discovery of quantum mechanical ideas when all the attempts to explain the experimental results within the classical framework of mechanics, electrodynamics and thermodynamics failed. The second part develops the rudiments of Schrodinger’s wave mechanics and apply the same to some simple systems (mostly 1-dimensional) that will help clarify the novelty of quantum mechanical concepts. The third and the final part introduces the formal structure of quantum mechanics thatwill lay the foundation for advanced courses.

**Textbooks:**

1. Principles of Quantum Mechanics, R. Shankar, Kluwer Publishers/ Plenum Press, Second Edition.
2. Introduction to Quantum Mechanics, D. J. Griffiths, and D. L. Schroeter, Cambridge University Press, Third

Edition, 2018.

**Reference books**

1. The Feynman Lectures on Physics, Volume III, Feynman, Leighton and Sands, Pearson India, 2012.
2. Berkeley Physics Course, vol. 4: Quantum Physics, McGraw-Hill, New York, 1971.

**Course Plan:**

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| --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | Introduction to Quantum behavior | A Gedanken experiment with bullets, waves and electrons | T1- Chapter 3, R1 |
| 2-5 | Origin of *h* | Discovery of quantum of action through seminal experiments: blackbody radiation, photoelectric effect, atomic stability | R1 |
| 6 | Link with classical mechanics | Path Integral | T1- Chapter 8 |
| 7-11 | Quantum Theory: Photons and Matter waves | Photoelectric effect, Compton effect, de Broglie waves | R2- Chapter 4 |
| 12-15 | The Bohr atom | Energy levels, Atomic spectra | T1-Chapter 13; R2 |
| 16-19 | Electron orbital motion | Quantization of angular momentum, Zeeman effect | T1-Chapter 12; R2 |
| 20-22 | Electron spin | Stern-Gerlach experiment | T1-Chapter 14; 2 |
| 23-28 | Wave function | Introduction to wave mechanics – Probabilistic ideas, Schrodinger equation | T2 – Chapter |
| 29-35 | Time-independent Schrodinger | 1-D problems: Potential well, potential barriers, Harmonic oscillators | T1-Chapter 5, 7; T2- Chapter 2 |
| 35-39 | Hilbert space fornalism | State vectors, Dirac’s bra-ket notation, observables as Hermitian operators, eigenvalues and eigenstates of Hermitian operators, the measurement postulate. | T2- Chapter 3 |
| 40 | Conclusion |  |  |

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| Mid-semester | 1.5 hours | 30 | 14/03 - 4.00 - 5.30PM | CLOSED |
| Quizzes |  | 30 |  | OPEN |
| Comprehensive exam | 3 hours | 40 | 14/05 AN | CLOSED |

**Chamber Consultation Hour:** Not yet decided.

**Notices:** Initial notices concerning CANVAS login information will be available in CMS. The course materials will be posted in CANVAS. Course evaluations may be conducted through CANVAS.

**Make-up Policy:**It is applicable to the following two cases and it is permissible on production of evidential documents:(i)Debilitating illness;(ii)Absent after obtaining prior permission from the Instructor.

**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.

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**INSTRUCTOR-IN-CHARGE**