

Principles of Quantum Mechanics

LECTURES 42

ASSIGNMENTS Once in 2/3 weeks, a set of assignment problems will be given. The solutions will be circulated a week later. Assignments have to be submitted on clean white paper with clarity in writing. Deadline for submission of assignments is non-negotiable.

PREREQUISITES Mathematics – I

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CONTENTS

Origin of Quantum Theory

- Review of Classical Physics – Failure of Classical Physics to explain Microscopic phenomena – Black body radiation – Photoelectric effect – Hydrogen emission spectra – Energy Quantization – Photons – Old Quantum theory – Correspondence Principle – Bohr–Sommerfeld Quantization – Wave–particle Duality – The measurement process and the Uncertainty Principle – Stern–Gerlach Experiment

Operators

- Operators – Eigenfunctions and Eigenvalues – Operators and Quantum mechanics – Degeneracy – Expectation values

Schrödinger's Formalism

- The Time–Dependent and Time–Independent Schrödinger equation – Born interpretation of Wavefunction – Properties of Wavefunction – Statistical Interpretation of Wavefunction – Hermitian Operators and Physical Quantities – Expansion of Wavefunction in terms of Ortho-normal functions – Eigenfunctions of Commuting operators

A few Model problems

- Particle in a One-dimensional and Three-dimensional Box – Free particle Wavefunction – Charged particle in an Electromagnetic field – Harmonic Oscillator – The Hydrogen Atom

Approximate Methods

- The Variational Principle – Non-degenerate Perturbation theory – Energy and Wavefunction corrections

Spin of an electron

- Electron spin – Spin and the Hydrogen atom – The Helium atom – Pauli Exclusion Principle – Spin Magnetic Moment

Applications

- A few real world applications of Quantum Mechanics will be discussed

REFERENCE BOOKS

- Albert Messiah, *Quantum Mechanics I*, Dover Publications, 1999.
- C. Cohen-Tannoudji, B. Diu, and F. Laloë, *Quantum Mechanics I & II*, Wiley-Interscience, 1992.
- J. J. Sakurai, *Modern Quantum Mechanics*, Addison Wesley, 1993. ✓
- J. J. Sakurai, *Advanced Quantum Mechanics*, Dorling Kindersley. ✓
- D. J. Griffiths, *Introduction to Quantum Mechanics*, Dorling Kindersley. ✓
- I. N. Levine, *Quantum Chemistry*, PHI learning. ✓