Course Handout Part-II

January 6,2015

Course Number: PHY F242
Course Title: Quantum Mechanics-I
Instructor-in-charge: RISHIKESH VAIDYA

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 three parts. The first part will begin with a historical perspective and will attempt to convey how radical quantum mechanical ideas were inevitably discovered when all the attempts to explain the experimental results within the classical framework of mechanics, electrodynamics and thermodynamics failed. The second part will then develop 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 will then elaborate on the formal structure of quantum mechanics that will lay strong foundations for the advanced courses.

Text and reference books: The course will draw heavily from following text and reference books:

1. Quantum Mechanics by Bransden and Joachain (BJ) 2nd Edition Pearson Education
2. Quantum Mechanics Vol. 1 by Shin-Itiro Tomonaga Inter Science publishers
3. Quantum Mechanics by John Powell and Bernd Crassemann (PC) Narosa Publishing House
4. Quantum Mechanics by David Bohm, Dover Publications

Lec. #	Learning objectives	Topics to be covered	Ref. #
1-4 (4)	To understand the inevitable emergence of quantum mechanics in explaining certain experimental results.	Blackbody radiation, theory of Specific heats and Plank's hypothesis	Ref. 2 chap.1, Ref. 1 chap. 1, and class notes
5-6 (2)	Understanding particle nature of radiation and making sense of wave-particle duality	Einstein's quantum theory of Photoelectric effect, Compton effect, dual nature of electromagnetic radiation	Ref. 2 Chap.2, Ref. 1 chap. 1. and class notes.
7-8 (2)	Understanding the origin of spectra in terms of Bohr model.	Atomic Spectra and Bohr Model of Hyrdrogen atom	Ref. 1, Sec. 1.4
9-10 (2)	Quantization of Angular momentum and wave particle dualism.	Stern Gerlach experiment and De-Broglie hypothesis	Ref. 1 Sec. 1.5, 1.6
11-16	Coherent systhesis of wave particle dualism	Interpretation of wave function, wave packets, and uncertainty principle.	Ref. 1 chap.2
17-26(10)	Understanding the structure and concepts related to the most important equation – the Schrodinger equation.	The Schrodinger equation, probability, expectation values and operators, Ehrenfest theorem, energy quantization and properties of energy eigenfunctions, schrodinger equation in momentum space	Ref. 1 chap.3
27-33 (7)	To see quantum peculiarities in	1 dimensional problems such as	Ref. 1 chap. 4

	simple quantum systems	potential step, potential barrier, square well, harmonic oscillator	
34-40 (7)	Introduction to the formal structure of Quantum Mechanics	State of a system, dynamical variables and operators, expansions in eigenfunctions, commuting observables, compatibility and Heisenberg uncertainty relations.	Ref. 1 Sections 5.1-5.4

Evaluation Scheme:

	Evaluation Comp.	**Duration**	**Weightage**	**Date, time, venue**	**Nature of component**
1	Mid-semester test	90 min	30 %	16/3 9:00 - 10:30 AM	Closed book
2.	Tutorial/Assignments		25-30%		
3.	Comprehensive Examination	3 hours	40-45%	9/5 FN	Open+Closed book