BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

INSTRUCTION DIVISION

FIRST SEMESTER 2015-2016

Course Handout (Part-II)

Date: 03/08/2015

In addition to part I (General handout for all courses appended to the timetable) this portion gives further details regarding the course.

Course Number : PHY F311/ PHY C321

Course Title : QUANTUM MECHANICS II / QUANTUM MECHANICS I

Instructor-in-Charge : TAPOMOY GUHA SARKAR

Scope & Objective of the Course:

Assuming a knowledge of elementary quantum mechanics covered in the Quantum Mechanics I/Modern Physics course, this course aims to expose the students to some advanced aspects of Quantum Mechanics.
The course starts with formal formulation of Quantum Mechanics with a stress on the exactly solvable problems. The course also covers several approximate methods for both the time dependent and independent case. A focus of the course is the the study of symmetries in QM specially through the detailed look at rotations.

Text Book:

T: Introduction to Quantum Mechanics (second edition), David J, Griffiths, Pearson Education

Reference Books:

R1: Quantum Mechanics B.H. Bransden, C. J. Joachain, (second edition) Pearson.
R2: Quantum Physics, Stephen Gasiorowicz, John Wiley and sons.
R3: Quantum Mechanics (second edition), E Merzbacher, Wiley.

Course Plan:

Lecture Number	Learning Objectives	Topics to be Covered	Reference
1-2 (2)	Review of Quantum theory	Revision of the observational motivation towards QM, Salient features of QM using the double slit experiment,Uncertainty-principle, Heisenberg's Gamma ray microscope, plane waves and wave packets, spreading of a Gaussian wave packet.	T: CHAPTER 1 R1: CHAPTER 2 R2: CHAPTER 1, 2
3-6 (4)	The language of Quantum mechanics	Linear Vector space (LVS), Structures on LVS, Dirac Notation, Operators, Review of Linear algebra, Function space. Eigen-value problem, The Fourier basis. Review of elementary probability theory. Finite dimensions to infinite dimensional spaces.	T: CHAPTER 3 R1: 5.1- 5.6 CLASS NOTES
7-14 (8)	Formalism	Description of a quantum state as a state vector and dynamical variables as operators. Representations in different basis, Matrix representation of Operators, Postulates of QM, Probability interpretation, Probability current and continuity equation. Unitary operators and their significance. Expectation values and Uncertainty principle Canonical commutation relations. Measurement in QM, Schrödinger equation. Time evolution. Schrödinger	T: CHAPTER 3, R1: 5.1-5.8 CLASS NOTES

		and Heisenberg Pictures. Classical Limit.	
15-16 (2)	The Harmonic Oscillator	Operator method for finding the energy spectrum. Ladder operators, Eigen functions of oscillator , Coherent states.	T: CHAPTER 2 SECTION 2.3 R1: 4.7
17-18 (2)	Symmetries and conservation principle	Linear momentum as the generator of space translation, Hamiltonian as the generator of time evolution.	CLASS NOTES R1 5.10
19-24 (6)	Angular Momentum	Rotations and Angular momentum. Angular momentum algebra, Operator method to find the eigen spectrum, Eigen functions. Spin, Pauli matrices, SU(2) [elementary] Stern Gerlach experiment and spin one-half. Addition of Angular momentum and CG coeffecients.	T: CHAPTER 4 SECTION 4.3, 4.4 R1 CHAPTER 6
25-27 (3)	3-D Central potential	Central potential, Hydrogen atom problem, 3D Oscillator.	T: CHAPTER 4 SECTION 4.1 4.2 R1 CHAPTER 7
28-32 (5)	Approximate Methods I Perturbative	Time independent Perturbation theory Degenerate and non-degenerate case Zeeman and Stark effect.	T: CHAPTER 6 R1 CHAPTER 8.1-8.2
33-34 (2)	Approximate Methods II Non perturbative	The Variational techniques.	T: CHAPTER 7 R1 8.3
35-37 (3)	Approximate Methods III Semi-classical	WKB method, Bound state and scattering states in 1D problems, Bohr quantization revisited. (Details of Airy's equation excluded asymptotic forms assumed)	T: CHAPTER 8 R1 8.4
38-40 (3)	Time dependent perturbation	Interaction picture, Dyson series, Application of perturbation technique for 2 state systems. Fermi's Golden rule (statement). Sudden and Adiabatic approximation.	T: CHAPTER 9 9.1-9.5

Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue	Nature of Component
2	Midterm	90 mins.	30	5/10 8:00 - 9:30 AM	Closed Book
3	Tutorials/Assigments		25		Closed Book/ Take home
4	Comprehensive Exam	3 hours.	45	1/12 FN	Closed Book + Open book

Chamber Consultation Hour: To be announced in the class.

Notices: Notices and solutions will be displayed only on **PHYSICS/FDIII** notice board.

Make-up Policy [STRICT] No Make-ups for tutorial tests. Make up for regular tests will be given only to genuine cases, *i.e.* (i) Sickness leading to ***hospitalization***, (ii) out-of-station with prior ***intimation to / permission from*** the IC.

Instructor-in-Charge

PHY PHYF311