Birla Institute of Technology & Science – Pilani, Goa
Instruction Division
First Semester 2019-2020

Course Handout (Part II)

Course No.: PHY F311

Course Title: QUANTUM MECHANICS - II Date: August 2 2018

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Instructor-in-charge: RADHIKA VATHSAN

1. Description and Objective: This course builds on the introduction to Quantum Physics provided in the course PHY F242, and provides a thorough grounding in the subject as required for MSc students. The course content basically covers Angular momentum and spin; Perturbation Theory; Symmetry; Scattering Theory and ends with the Dirac Equation of relativistic quantum mechanics.

2. Text Books

[**T**] Text: *"Introduction to Quantum Mechanics"*, David Griffiths, Ed. 2, Pearson Education, 2005.

[**R1**] Reference: *"Modern Quantum Mechanics"* J. J. Sakurai, Pearson Education, 1994.

[**R2**] Reference: *"Principles of Quantum Mechanics"*, R Shankar (Ed. 2), Springer, 1994.

[**R3**] Reference: The Feynman lectures on Physics, Vol 3, Addison Wesley 1965

3. Learning Outcomes Upon completing this course, students will be able to:

1. demonstrate knowledge of the fundamental principles of Quantum Mechanics
2. recognize symmetries of a quantum system and relate them to conservation laws and selection rules
3. demonstrate knowledge of angular momentum algebra and operations and construct composite states
4. apply the methods of perturbation theory to solve problems in atomic physics
5. apply techniques of quantum scattering theory
6. be aware of the relativistic quantum equation of Dirac

4. Course Plan:

Week	Learning Objective	Topics	Ref.
1	Introduction and Recap	States, observables, measurement, representation, expectation values, wave functions	T Ch 1-3, class notes
2 –3	Angular momentum	Rotations and angular momentum operators: commutation relations, eigenvalues and eigenstates, Orbital Angular momentum, Spin, Addition of angular momentum	T 4.3, 4.4 , R1 3.1,3.2, 3.5, 3.6, 3.7

4	Symmetries and their Consequences	Symmetry, conservation laws and degeneracies: translational and time-translational invariance, Discrete symmetries, parity, time reversal symmetry	R1 Ch4
5–6	Perturbation Theory	Time-independent perturbation theory, degenerate case, Stark effect, fine structure, Zeeman effect	T Ch6, R1 5.1–5.3
7–8	Time-dependent potentials	Time dependent perturbation theory, harmonic perturbation, stimulated emission	T Ch9, R1 5.5–5.7
9	Identical particles	permutation symmetry, Bosons and Fermions, Exclusion principle, Helium atom.	T Ch5, R1 Ch 6
10–11	Scattering theory	Introduction, scattering cross-section, Born approximation, Partial Wave analysis	T Ch11 R1 7.5–7.7, R2 Ch 19
12	Adiabatic Approximation	Adiabatic theorem and Berry phase	T1 ch10
13	Special topics	Feynman Path integral OR Relativistic quantum mechanics & the Dirac Equation	Class notes

5. Workload in hours per week:

Lecture/Class:	2
Tutorial:	2
Home assignments etc:	3
Preparatory work	3
Total:	10

6. Evaluation Scheme:

Comp No.	**Component**	**Duration**	**Weightage**	**Date, time**	Remarks
1.	Class participation	all classes	5 %	in class	
2.	Midsem	90 min	20%	TBA	Cheat sheet allowed
4.	Assignments	weekly	20%		in-class/take home
5.	Seminar/term paper		20%	term end	take home
6.	Comprehensive Exam	3 hrs	35%	TBA	cheat sheet allowed

7. Notices: on the course moodle site.

8. Make-up Policy: Make-up will be given only for Midsem or Compre, and only in genuine cases, that is, serious illness leading to hospitalization or going out of station with prior permission.

Instructor-in-charge
PHY F311