Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NPHC508	QUANTUM MECHANICS - II	3	1	0	4

Course Objective
To introduce the advanced concepts of quantum mechanics such as interaction of radiation and matter, symmetries and conservation laws, scattering, relativistic quantum mechanics, and elementary quantum field theory,
Learning Outcomes
On successful completion of this course, a student should be conversant with the concepts of scattering theory, relativistic quantum mechanics, mechanics of identical particles and the idea of quantum field theory.

Unit No.	Topics to be Covered	Lecture Hours	Tutorial Hours	Learning Outcome
1	**Time-Independent Perturbation theory:** Time-independent Perturbation theory (non-degenerate and degenerate) and applications to fine structure splitting, Zeeman effect (Normal and anomalous), Stark effect.	7	2	Students will learn real application of some approximation method to solve quantum systems and compare with well-established experimental phenomena like Zeeman effect, Stark effect etc.
2	**Time-dependent Perturbation theory:** Transition probability for constant and harmonic perturbation, Fermi's Golden rule, selection rule, Semi-classical theory of interaction of atoms with radiation. Adiabatic approximation, Sudden approximation	7	3	Students will learn time-dependent perturbation theory and its various applications. A special focus will be
3	**Scattering Theory:** Scattering amplitude and cross-section, Partial wave analysis and application to simple cases; Integral form of scattering equation, Born approximation validity. The optical theorem.	8	2	To understand the quantum basis of scattering theory as a framework for studying and understanding the scattering of particles.
4	**Path Integral formulation of Quantum Mechanics:** Introduction and mechanism, Free particle propagator, Path-integral form of Schroodinger equation, Path-integral in phase Space.	7	2	Students will learn an entirely different technique in the formulation of quantum mechanics.
5	**Relativistic Quantum Mechanics:** The Klein-Gordon equation. The Dirac equation. Dirac matrices, spinors. Magnetic Moment and Spin of electron; Positive and negative energy solutions, physical interpretation. Non relativistic Limit of the Dirac equation.	7	3	To understand the relativistic formalism which can be used to describe particles and their interactions.
6	**Identical Particles:** Symmetric and antisymmetric wave functions: Bosons and Fermians, symmetrization postulates, Pauli's exclusion principle, Spin-statistics, Second quantization formalism.	6	2	To learn methods to describe the mechanics systems made-up of identical indistinguishable quantum particles.
	Total	**42**	**14**	

Text Books:

1. Relativistic Quantum Mechanics: Wave Equations, 3/Ed; W. Greiner; Springer Int.; 2006.
2. Modern Quantum Mechanics; J.J. Sakurai; Pearson; 1994.

Reference Books:

1. Relativistic Quantum Mechanics: Bjorkenand Drell; McGraw-Hill;1998.
2. Quantum Field Theory, Rev. Ed.; Mandland Shaw; Wiley; 1993.
3. Principles of Quantum Mechanics; Shankar; Springer;2006.
4. Quantum Computation and Quantum Information: M.A. Nielsenand I.L. Chuang, Cambridge University Press.
5. An Introduction to Quantum Field Theory; Peskin and Schroeder; Westview Press; 1995.