Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NPHC503	QUANTUM MECHANICS - I	3	1	0	4

Course Objective
Course introduces the methods to do the mechanics of atomic and subatomic particles.
Learning Outcomes
Familiarizing students with the theoretical framework of non-relativistic quantum mechanics and its applications to simple problems.

Unit No.	Topics to be Covered	Lecture Hours	Tutorial Hours	Learning Outcome
1	**Schrödinger Equation:** Derivation, Equation of continuity, Applications to 3D harmonic oscillator, 3D spherical potential and hydrogen atom problems.	6	2	Students will learn how to solve time dependent and time independent Schrödinger Equation for various simple quantum systems.
2	**Mathematical foundation of quantum mechanics:** Linear vector space, Dirac notations of Bra - Ket, Operators, different types of operators, Determination of eigenvalues and eigen state using matrix representations, Basis representation, Operator algebra for harmonic oscillator, Postulates of quantum mechanics, Space and momentum representations, Change of representation and unitary transformations,	6	2	Students will learn the mathematical tools required for the development and application of nonrelativistic quantum mechanics.
3	**Quantum conditions and quantum dynamics**: Dirac's quantum condition, evolution of state, Heisenberg equation of motion, Eherefest theorem, Equations of motion in Schrödinger, Heisenberg and Dirac pictures	6	2	Students will learn the tools from transition from the classical to quantum mechanics and equation of motion in quantum mechanics.
4	**Theory of Angular Momentum:** Symmetry, invariance and conservation laws, relation between rotation and angular momentum, commutation rules, Matrix representations, addition of angular momenta and Clebsch-Gordon coefficients, spin-orbit coupling and fine structure, Pauli spin matrices.	7	3	Students will learn about orbital angular momentum and spin of quantum particles and their application in understanding various quantum systems.
5	**Symmetry in quantum mechanics:** Translational and rotational symmetry, Time-reversal symmetry, Symmetry transformation, Special unitary group (SU(n)), symmetries and conservation laws	6	2	Students will learn about symmetries and the associated conservation laws in quantum mechanics.
6	**Variational method** and applications to harmonic oscillators and helium atom.	5	1	Students will learn how to apply this time independent approximation method to solve simple quantum system like He atom
7	**WKB approximation:** Semiclassical approximation, Schroodinger equation for slowly varying potential, Validity, The connection formula. Applications to tunneling potential cases.	6	2	Students will learn WKB approximation method in detail and apply in simple quantum systems
Total		**42**	**14**	

Text Books:

1 Introduction of Quantum Mechanics; David J. Griffiths; Pearson Education; 2010.
2 Quantum Mechanics, Concepts & Applications, N. Zettili, Wiley, 2016.
3 Quantum Mechanics 2nd Ed; Bransden and Joachain; Pearson; 2000.

Reference Books:

1 Quantum Mechanics: An introduction, W. Greiner, Springer (India) Pvt. Ltd., 2001.
2 Principles of Quantum Mechanics; Shankar; Springer; 2006.
3 Quantum Mechanics, 3rd Edition; Merzbacher; John Wiley; 2005.
4 Principles of Quantum Mechanics; P.A.M. Dirac; Oxford University Press, 1982.
5 Feynman Lecture, Vol. 3, Addison-Wesley, 2005.
6 Quantum Mechanics, C. Cohen-Tannoudji, B. Diu, F. Laloe, Wiley-VCH, 2005.
7 Quantum Mechanics: Theory And Applications, 1e; Ghatak and Lokanathan; Kluwer Academic Publishers; 2004.
8 Non-relativistic Quantum Mechanics, R. R. Puri, Cambridge University Press, 2017.
9 Quantum Mechanics; V. K. Thankappan; New Age International Pub; 1993.