Pandit Deendayal Petroleum University **School of Liberal Studies**

16BSP602					Introduction to Quantum Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- **T**o acquire the basic knowledge of inadequacies of classical physics & concepts of quantum theory
- To learn and adopt mathematical techniques for quantum mechanics
- To obtain the solutions for Schrodinger equation for various cases and analyzes them.
- To solve Schrodinger equation for H2 atom and derive expression for angular momentum.

UNIT 1 Particles and waves	**12 Hrs.**
Inadequacies in Classical Physics. Blackbody Radiation: Quantum Theory of Light. Photoelectric Effect. Compton Effect. Franck-Hertz experiment. Wave Nature of Matter: De Broglie Hypothesis. Wave-Particle Duality. Davisson-Germer Experiment. Wave description of Particles by Wave Packets. Group and Phase Velocities and Relation between them. Two- Slit Experiment with Electrons. Probability. Wave Amplitude and Wave Functions. Heisenberg's Uncertainty Principle and it's applications.	
UNIT 2 Mathematical Tools for Quantum Mechanics	**12 Hrs.**
The linear vector space, Hilbert Space, square integrable wave function, Dirac notations, Operators: Hermitian adjoint, Projection operators, commutator algebra, inverse and unitary operators, Eigen value and Eigen vectors of operators, Matrix representation of bra, ket and operators, Matrix representation of Eigen value problem, representation in continuous basis, wave and matrix mechanics, postulates of quantum mechanics, measurements in quantum mechanics, Time evolution of system's state, The Ehrenfest's theorem	
UNIT 3 One dimensional Problems	**14 Hrs.**
Properties of One dimensional problem: Discrete, continuous and mixed spectrum, Free particle, potential step, potential barrier and well, tunnelling effect, Infinite square well: Unsymmetrical and symmetric potential, finite square well potential: Scattering and bound state solutions, harmonic oscillator.	
UNIT 4 Hydrogen atom and angular momentum	**12 Hrs.**
Quantum Theory of Hydrogen Atom: Particle in a Spherically Symmetric Potential. Schrodinger Equation. Separation of Variables. Radial Solutions and Principal Quantum Number, Orbital and Magnetic Quantum Numbers. Quantization of Energy and Angular Momentum. General formalism of angular momentum, spin angular momentum, Pauli matrices, Eigen function of Lz and L2, Properties of Spherical Harmonics.	
Max. 50 Hrs	

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - identify and understand the experimental results incompatible with classical physics and introduce concepts of quantum theory.

CO2 - interpret the wave function by applying the operators and analyze the information about the system.

CO3 – demonstrate an ability to use various mathematical tools for better understanding of quantum theory.

CO4 - examine the solutions of Schrodinger equation for various cases & analyze the output.

CO5 – appraise the results for hydrogen atom spectrum and angular momentum of the system.

CO6 - solve the numerical based on the concepts of quantum theory.

TEXT/REFERENCE BOOKS

1. L. I. Schiff, Quantum Mechanics, 3rd edition, (McGraw Hill Book Co., New York 1968).

2. N. Zettili, Quantum Mechanics: Concepts and applications, Willey Publications

3. Principles of quantum Mechanics, R. Shankar, Plenum Publishers.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> **<> Marks**

Part B/Question: <Details> **<> Marks**