

# SARDAR PATEL UNIVERSITY

Programme: B.Sc (Physics)

Semester: VI

Syllabus with effect from: November/December-2013

|  |                        |
|--|------------------------|
| <b>Paper Code: US06CPHY01</b>            | <b>Total Credit: 3</b> |
| <b>Title Of Paper: Quantum Mechanics</b> |                        |

| Unit | Description in detail   | Weighting (%) |
|------|---|---------------|
| I    | <p><b>Formulation of the Schrödinger Equation</b><br/>                     Brief introduction of De Broglie's Hypothesis, Concept of wave packet and uncertainty principle, <b>The Schrödinger Equation:</b> A free particle in one dimension, Generalization to three dimensions, The operator correspondence and the Schrödinger equation for a particle subject to forces, <b>Physical Interpretation and Condition on <math>\psi</math>:</b> Normalization and probability interpretation, Non-normalizable wave function and box-normalization, Conservation of probability, Expectation value and Ehrenfest's theorem, Admissibility conditions on the wave function, Related Numericals</p>  |               |
| II   | <p><b>Stationary States and Energy Spectra</b><br/>                     Stationary States: The time independent Schrödinger wave equation, A particle in a square well potential, Bound state in a square well potential (<math>E &lt; 0</math>), Admissible solutions of wave equation, The energy eigenvalues – discrete spectrum, The energy eigenfunctions, parity, Penetration into classically forbidden regions, Square well : Non-localized states(<math>E &gt; 0</math>), The square potential barrier: Quantum mechanical tunneling, Reflection at potential barriers and wells, The Schrödinger equation and probability for N-particle system, The fundamental postulates of wave mechanics</p>   |               |
| III  | <p><b>General Formalism of Wave Mechanics</b><br/>                     The adjoint of an operator and self adjointness, The eigenvalue problem: Degeneracy, Eigenvalues and eigenfunctions of self adjoint operators, The Dirac delta function, Observables: Completeness and normalization of eigenfunctions, Closure, Physical interpretation of eigenvalues, eigenfunctions and expansion coefficients, Momentum eigenfunctions: wave functions in momentum space, The uncertainty principle, States with minimum value for uncertainty product, Commuting observables; removal of degeneracy, Evolution of system with time; constants of the motion</p>  |               |
| IV   | <p><b>Exactly Soluble Eigenvalue Problems</b><br/> <b>The Simple 'Harmonic Oscillator:</b> The Schrödinger equation and energy eigenvalues, The energy eigenfunctions, Series solution; Asymptotic behaviour, Orthonormality, Properties of stationary states, Angular <b>Momentum and Parity:</b> The angular momentum operators, The eigenvalue equation for <math>L^2</math>; Separation of variables, Admissibility conditions on solutions; eigenvalues, The eigenfunctions: Spherical harmonics, Physical interpretation<br/> <b>Angular momentum in stationary states of system with spherical symmetry:</b> The rigid rotator, A particle in a central potential; the radial equation, The radial wave function, The Hydrogen Atom: Solution of the radial equation and energy levels, The Anisotropic oscillator, The Isotropic oscillator</p> |               |



### **Basic Text & Reference Books :-**

- A Textbook of Quantum Mechanics  
P M Mathews and K Venkatesan, Second Edition, Tata McGraw Hill, New Delhi
- Introduction to Quantum Mechanics  
David J Griffiths, Second Edition, Pearson
- Quantum Mechanics Theory and applications  
Ajoy Ghatak and S Lokanathan, McMillan Publishers India Limited, Delhi
- Quantum Mechanics  
Leonard I Schiff, McGraw Hill Book Co.

