PARVATHANENI BRAHMAYYA
SIDDHARTHA COLLEGE OF ARTS & SCIENCE
Autonomous
Siddhartha Nagar, Vijayawada–520010
Re-accredited at 'A+' by the NAAC

Paper 2: QUANTUM MECHANICS-I

Offered to : M.Sc.(PHYSICS)	Course Code : 22PH2T2
Course Type : Core	Course : QUANTUM MECHANICS-I
Year of Introduction : 2004	Year of offering : 2022
Year of Revision : 2022	Percentage of Revision : NIL
Semester : II	Credits : 4
Hours Taught: 60 hrs. per Semester	Max.Time: 3 Hours

Course Description: Quantum mechanics I describes the physical systems at the scale of atoms and subatomic particles. It is the foundation of all quantum physics including quantum chemistry, quantum field theory, quantum technology, and quantum information science

Course Objectives:

1. To solve Schrodinger equation for different systems and find energy Eigen values and Eigen functions.
2. To learn the mathematical formulation of quantum mechanics
3. To study equation of motion in different pictures and states of identical particles.
4. To learn solving time independent perturbation problems.
5. To learn solving time dependent perturbation problems.

Course Outcomes: At the end of this course, students should be able to:

CO1: Understand the basic concepts of Schrodinger equation and using it solve different problems
CO2: Define all operators of quantum mechanics.
CO3: Apply the concept of equation of motion to different problems in different pictures.
CO4: To solve time independent perturbation problems
CO5: To solve time dependent perturbation problems

CO - PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
22PH2T2	CO1	H					L	M
	CO2	H					L	M
	CO3		H				L	M
	CO4	H	M				L	M
	CO5		H	M			L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**Schrodinger wave equation and potential problems in one dimension** Inadequacy of classical mechanics, Necessity of quantum mechanics, Postulates of Quantum Mechanics, Physical interpretation of the wave function, Normalized and orthogonal wave functions, (i) Time independent Schrödinger equation (iii) Time dependent Schrödinger equation, Expectation values of dynamical quantities, Continuity equation, Ehrenfest theorem, Stationary states, ***One - dimensional problems****:* Particle in a box, Potential step, Rectangular potential barrier, Linear Harmonic oscillator by Schrodinger equation.	12
II	**Linear Vector spaces and Operators** Linear Vector Space, Hilbert space, Linear operators: Momentum Operator, Hamiltonian Operator, Hermitian operators and their properties, Parity Operator, Projection Operator, Inverse and Unitary Operators, Eigen values and Eigen functions of an Operator, Dirac's Bra and Ket notations, Uncertainty relation between two operators, Commutator algebra.	12
III	**Equation of motion and Identical Particles** Equation of motion in Schrodinger's picture and Heisenberg's picture, Correspondence between the two, Correspondence with classical mechanics, Application of Heisenberg's picture to Harmonic oscillator, The indistinguishability of identical particles, Symmetric and anti symmetric wave functions, Creation, Annihilation operators and their properties.	12
IV	**Time-independent perturbation** Time-independent perturbation theory: Non-degenerate perturbation theory - evaluation of first order perturbation and second order perturbation - Ground state of Helium atom. Degenerate perturbation theory-Effect of electric field on the n=2 state of Hydrogen (Stark effect in Hydrogen), Variation method - ground state of Helium atom, WKB approximation method, Validity of WKB	12

	method.	
V	**Time dependent perturbation** Introduction, Time - dependent perturbation: General perturbations, variation of constants, and transition into closely spaced levels – Fermi's Golden rule, Interaction of an atom with the electromagnetic radiation, Absorption and emission of radiation, Einstein transition probabilities, Sudden and adiabatic approximation	12

Reference Books:

1. Quantum mechanics: Concepts and Applications, N. ZETTILI (John Wiley &Sons).
2. Quantum Mechanics : G. Aruldhas
3. Quantum Mechanics: D.J. Griffith, Prentice Hall
4. Foundations of Quantum Mechanics, R.D. RATNA RAJU (I.K. IntPubHouse).
5. Quantum Mechanics, L.I. SCHIFF(McGraw-Hill).