COEP TECHNOLOGICAL UNIVERSITY, PUNE
A Unitary Public University of Government of Maharashtra
(formerly College of Engineering Pune)
School of Transdisciplinary Sciences & Management
Wellesley Road, Chhatrapati Shivajinagar, Pune - 411005.

Course Title: Quantum Physics (QP)

Course Code		**Scheme of Evaluation**	Marks
Teaching Plan (L-T-P-S)=TC	2-0-0-1= 2	**TA/MSE**	20/30
Credits	2	**ESE**	50

Course Objectives:

1) Understand the role of uncertainty principle in quantum physics.
2) Apply the Schrodinger equation to solve 1D quantum mechanical system.
3) Apply the expectation value of an operator to obtain physical properties of the particle.
4) Understand the expectation value of an operator using matrix formalism.

Syllabus:

Unit	Contents	Lecture
01.	**Wave properties of particles** Wave packets, motion of wave packets, phase velocity, group velocity, relation between phase and group velocity, Heisenberg's uncertainty principle (HUP) with proof. Electron diffraction and γ- ray microscope, Applications of HUP: β-decay and Bohr radius, ground state energy calculation of Harmonic Oscillator (HUP)	**7** 5
02.	**Applications of the Schrodinger's wave equation** Schrödinger's time dependent and time independent equations (with derivation), Potential barrier and quantum tunneling, and Hydrogen atom (qualitatively)	7
03.	**Operators in Quantum Mechanics** Hermitian operator, position, Linear momentum operator, angular momentum operator, Laplacian operator, total energy operator (Hamiltonian), commutator algebra, commutator brackets using position, spin angular momentum operator, concept of parity, parity operator, Projection operator, Unitary operator, Trace of an operator, Eigen values and simultaneous Eigen function, Ladder operator, Harmonic oscillator (1D)	10
04.	**Many Electrons Atoms** Concept of electron spin, Spin angular momentum with Stern - Gerlach experiment, Pauli Matrices, Expectation value of an operator and Density matrix formalism for two level – spin ½ systems (Qubits).	**7**

Course outcomes:

After the completion of the course, students should be able to

1. apply the role of uncertainty principle in quantum physics.
2. operate the Schrodinger equation to solve 1D quantum mechanical system.
3. apply operators to obtain physical properties of a particle.
4. evaluate the expectation value of an operator using matrix formalism.

Suggested learning resources:

1) Modern Physics, 6th Edition, Arthur Beiser, Shobhit Mahajan, S Rai Choudhury
2) Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths
3) A Textbook of Quantum Mechanics, 2nd Edition, P. M. Mathews, K. Venkatesan
4) Quantum Mechanics – Theory and Applications, 3rd Edition, A. K. Ghatak, S. Lokanathan
5) Quantum Mechanics by L. I. Schiff
6) Modern Quantum mechanics by J. J. Sakurai
7) Quantum Mechanics: Concepts and Applications, 2nd edition by N. Zettili, Wiley Pub