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

Course Title: Quantum Physics(QP)

Course Code	PH23002	**Scheme of Evaluation**	CE & ESE
Teaching Plan (L-T-P-S)=TC	2-0-0-1= 2	**T1 & T2**	20 Marks Each
Credits	2	**ESE**	60 Marks

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) Evaluate the expectation value of an operator using density 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: Bohr radius, β-decay and ground state energy calculation of Harmonic Oscillator.	**7**
02.	**Applications of the Schrodinger's wave equation** Schrödinger's time dependent and time independent equations (with derivation), Potential barrier and quantum tunneling, Harmonic oscillator (1D) and Hydrogen atom (qualitatively)	7
03.	**Operators in Quantum Mechanics** Hermitian operator, position, momentum operator, angular momentum operator, total energy operator (Hamiltonian), commutator algebra, commutator brackets using position, momentum and angular momentum operator, Ladder operator, concept of parity, parity operator, Projection operator, Unitary operator, Eigen valuesand simultaneous Eigen function.	**7**
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 1Dquantum 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, 6thEdition, 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

Course Title: Quantum Physics Laboratory

Course Code	PH23002	**Scheme of Evaluation**	CE & ESE
Teaching Plan (L-T-P-S)=TC	0-0-2-0 = 2	Term work	50 Marks
Credits	1	**ESE-** Oral+ Experiment	50

Course Objectives:

1. To understand the basic concepts and principles in quantum mechanics
2. To verify quantum mechanical phenomena.

List of Experiments:

1. Stefan's law
2. Photoelectric effect
3. G. M. Counter
4. Stern Gerlach experiment
5. Davisson and Germer experiment
6. γ - (Gamma) ray microscope experiment
7. Electron diffraction experiment.
8. Zeeman effect
9. Compton Effect
10. X-ray diffraction

Course Outcomes:

Students should be able to:

1. Verify concepts and principles in quantum mechanics
2. Determine the quantum mechanical variables