Sankalchand Patel University
Faculty of Science & Humanities
Master of Science (Physics) (Sem-3)
In Effect from Academic Year 2022-23

Subject Code:1SC2050301	**Subject Title: Advanced Quantum Physics**

COURSE OBJECTIVE:

Physics is a science to understand the nature. This course is designed to get basic understanding of the physical world.

LEARNING OUTCOMES:

- Develop an actual understanding of use of Advanced Quantum Physics.

Teaching scheme (hours) per week		**Credit**		**University Examination**		**Internal Examination**		**Total**
Theory	**Practical**	**Theory**	**Practical**	**University Assessment**	**Practical**	**Internal Assessment**	**Practical**	
4	**--**	**4**	**--**	**60**	**-**	**40**	**---**	**100**

Unit	Content	Lectures	Weight (%)
1	Scattering theory –Kinematics of the scattering process, Differential and total Wave mechanical picture of scattering, Scattering amplitude and its formal expression by Green's function. The Born approximation and its validity through examples, Partial wave analysis, Asymptotic behaviour of partial waves, phase shifts and scaterring amplitude,Optical theorem. Phase shifts-relation with the potential. Potential of finite range. The eikonal approximation. Applications.	15	25
2	**Time Independent Perturbation theory:** Perturbation theory for discrete levels, Equation invarious orders of perturbation theory, The non corrections, The degenerate case,The variation method: Upper bound on ground state energy.Application to excited states.Theground state of a two electron atom.The Hydrogen molecule. **The WKB approximation:** The one dimensional Schrödinger equation, the asymptoticsolution.Solution near turning point,matching at turning points and connection formulae.The Bohr-Sommerfeld quantum condition.WKB solution of the radial wave equation.	15	25
3	Evolution of system with time, The Schrödinger equation and general solution, propagators, sudden approximation, perturbative solution for transition amplitude, First ans second order transition scattering of a particle by a potential, Harmonic perturbations, amplitude transition with, change of energy, Interaction of an atom with electromagnetic radiation approximation, Einstein coefficients. Alternative pictures of time evolution, the Schrödingerpicture the Heisenberg picture and the interaction picture	15	25
4	Relativistic wave equations, generalization of the Schrödinger equation, the Klein-Gordonequation and its plane wave solutions. Dirac's relativistic Hamiltonian and the Dirac equation,position probability density and expectation values, Dirac matrices, plane wave solution of the Dirac equation, the spin of the Dirac particles, significance of the negative energy states,Relativistic electron in central potential, electron in magnetic field and spin magnetic moment.	15	25

Basic Reference book:

1. A text book of Quantum Mechanics, by Mathews &Venkatesan, TMH Publication (2010).
2. Quantum Mechanics by V. K. Thankappan
3. Quantum Mechanics by Ghatak&Loknathan; McMillan India Publication.
4. Quantum Mechanics by G. Aruldas, Prentice-Hall India, Pvt., Ltd.