SC 511T					Quantum Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concepts of time-independent perturbation theory and their applications to physical situations.
- To impart knowledge about the approximation methods corresponding to time-dependent perturbation theory.
- To enable the students to extract the structure of matter from the scattering of particles.
- To provide an understanding of the formalism and language of relativistic quantum mechanics.

UNIT 1 Approximation methods for stationary states	13 Hrs.
Brief introduction to identical particles and symmetry, Time-independent perturbation theory for discrete levels, non-degenerate cases and degenerate case, removal of degeneracy, Zeeman effect, Stark effect, spin-orbit coupling, fine structure of hydrogen, variational method and its application, WKB approximation.	
UNIT 2 Time dependent perturbation theory	**13 Hrs.**
Time dependent perturbation theory, Interaction picture, Transition amplitude, First- order perturbation, Harmonic perturbation, Transition probability, Second -order perturbation, Adiabatic and sudden approximation, Interaction of an atom with electromagnetic radiation (semi classical treatment), Absorption and emission of radiation. The dipole approximation, selection rules.	
UNIT 3 Scattering Theory	**10 Hrs.**
Non-relativistic scattering theory, scattering amplitude and cross-section, the integral equation for scattering, Born approximation, partial wave analysis, optical theorem.	
UNIT 4 Relativistic quantum Mechanics	**14 Hrs.**
Relativistic Quantum Mechanics: Klein-Gordon equations, charge & current densities, physical interpretations and short comings of K-G equation, Dirac equation and its derivation, Dirac matrices and their properties, constant of motion for Dirac equation (spin of Dirac particle), electron in electromagnetic field, Spin-orbital interaction energy , free particle solution of Dirac equation, negative energy states and the concept of hole, Dirac equation for spherically symmetric potential, deduction of K-operator and commutation relations for H, K and J; Eigenvalues of K, reduction of Dirac equation to a radial equation, solution of radial equation for hydrogen-like atom, fine structure corrections to energy. **Max 50 Hrs**	

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - to grasp the concepts of spin and angular momentum, as well as their quantization and addition rules.
CO2 - familiar with various approximation methods applied to atomic, nuclear and solid-state physics
CO3 - describe the principles of scattering theory
CO4 - explain the relativistic quantum mechanical equations, namely, Klein-Gordon equation and Dirac equation
CO5 - Understand the underlying concepts of relativistic quantum field theory.
CO6 - Solve conceptual and mathematical problems associated with the topics covered in Quantum Mechanics.

TEXT/REFERENCE BOOKS

1. J. J. Sakurai, Modern Quantum Mechanics, Benjamin /Cummings, 1985.
2. Principles of quantum Mechanics, R. Shankar, Plenum Publishers.
3. L. Schiff, Quantum Mechanics, McGraw-Hill, 1968.

4. N. Zetilli, Quantum Mechanics: Theory and applications

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <> Marks

Part B/Question: <Details> <> Marks