PH-8203 Quantum Mechanics-II

L	T	P	C
4	1	0	5

Course Outcomes:

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

CO1: Understand the interaction of the electromagnetic field with charged quantum-mechanical particles and solve related problems such as the rate of absorption and emission of light.

CO2: Study the selection rules for transitions between different quantum states &

CO3: Calculation of scattering cross-sectional area using Born-approximation & partial wave analysis method.

CO4: Study of Relativistic Quantum Mechanics.

CO5: Study of identical particles from Quantum mechanical point of view.

CO/PO Mapping

S-strong, M-medium and W-weak indicate the strength of correlation

COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	W	S	S	S		M	S	S	S	S
CO2	S	S	S	M	M	S	M	M	M	W	M	M
CO3	S	S	M	S	S	S	W	S	S	M	S	S
CO4	S	S	W	M	S	S	M		M	S	M	S
CO5	S	S	S	M	S		S	M	S	S	M	S

PH-8203: Quantum Mechanics-II

L	T	P	C
4	1	0	5

UNIT-I

Time Dependent Perturbation:
First order time dependent perturbation theory, General expression for the probability of transition from one state to another, constant and harmonic perturbations, Fermi's golden rule and its application to radiative transition in atoms, Selection rules for emission and absorption of light. The Helium atom problem. Stark effect. **(15 Hrs)**

Scattering theory:
Scattering Cross-section and scattering amplitude, partial wave analysis, Low energy scattering, Green's functions in scattering theory, Born approximation and its application to Yukawa potential and other simple potentials and extend to higher orders. Validity of Born approximation for a square well potential, Optical theorem, unitarity and phase shifts. Determination of phase shift, applications to hard sphere scattering. Low energy scattering in case of bound states, Scattering of identical particles. **(15 Hrs)**

UNIT-II

Relativistic Quantum Mechanics:
Schrodinger's relativistic equation, Klein Gordon equation in presence of electromagnetic field, Dirac Equation for free electron, Positive and negative energy solutions of Dirac equation, Negative energy states: positrons, Properties of gamma matrices. Probability and current densities, Dirac's equation in electromagnetic field, Dirac's equation in central field (The electron spin) . Spin Orbit energy. **(16 Hrs)**

Identical Particles:
Brief introduction to identical particles in quantum mechanics (based on Feynmann Vol. III), principle of indistinguishability of identical particles, construction of symmetric and antisymmetric wave function, exchange symmetry of wave function, particle exchange operator, Statistics of identical particles: Bose Einstein and Fermi Dirac Statistics, Pauli exclusion principle & Electron spin, Pauli spin operators, commutation relations, Application to 2-electron systems. Symmetric and anti-symmetric wave-functions of hydrogen molecule. **(14 Hrs)**

Total: 60 Hrs

Theory: 60 Hrs

BOOKS:

1. Modern Quantum Mechanics by J. J. Sakurai (Principal text)-Pearson Education Pvt. Ltd., New Delhi, 2002.
2. Quantum Mechanics by L I Schiff-Tokyo Mc Graw Hill, 1968.
3. Feynman lectures in Physics Vol. III-Addison Wesly, 1975.
4. Quantum Mechanics by Powel and Craseman-Narosa Publication, New Delhi, 1961
5. Quantum Mechanics by Merzbacher-John Wiley & Sons, New York, 1970.

c/BOS

Head
Department of Physics
Sant Longowal Inst. of Engg. & Tech.
LONGOWAL (Sangrur)