

M.Sc.Physics Semester II Paper VIII
Quantum Mechanics –II 22PHY22C2

Theory Marks: 80

Time: 3 Hours

COURSE OUTCOMES

- CO1 Students would be able to explain ground state of hydrogen and helium molecules.
- CO2 Students get enabled to analyze various transitions and their selection rules.
- CO3 Students would be capable to understand 3D collisions.
- CO4 Students would be capable to calculate spin states of identical particles.

Unit I

Variational methods: Ground state of Helium by both variational and perturbation methods; The hydrogen molecule; WKB approximation; Time dependent perturbation theory; Constant perturbation; Harmonic perturbation; Fermi's golden rule; Adiabatic and sudden approximation.

Unit II

Semi-classical theory of radiation: Transition probability for absorption and induced emission; Electric dipole transition and selection rules; Magnetic dipole transitions; Forbidden transitions; Higher order transitions; Einstein's coefficients.

Unit III

Collision in 3D and scattering: Laboratory and C.M. reference frames; scattering amplitude; Differential scattering cross section and total scattering cross section; The optical theorem; Scattering by spherically symmetric potentials; Partial waves and phase shifts; Scattering by a perfectly rigid sphere and by square well potential; Complex potential and absorption; The Born approximation.

Unit IV

Identical particles: The principle of indistinguishability; Symmetric and antisymmetric wave functions; Spin and statistics of identical particles; The Slater determinant; The Pauli exclusion principle; Spin states of a two-electron system; States of the helium atom; Collision of identical particles.

Note: The syllabus is divided into four units. Nine questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit. A student has to attempt five questions in all.

Text and Reference Books:

- [1] Quantum Mechanics by Ghatak and Loknathan
- [2] Quantum Mechanics by Powell and Crassman
- [3] Quantum Mechanics by S.Gasiorowicz
- [4] Quantum Mechanics by A.P.Messiah
- [5] Modern Quantum Mechanics by J.J. Sakurai
- [6] Quantum Mechanics by L.I.Schiff
- [7] Quantum Mechanics by Mathews and Venkatesan.