AU–301

M.Sc. Semester—II (CBCS Scheme) Examination

PHYSICS

(2-PHY-2 : Quantum Mechanics—II)

Time : Three Hours] [Maximum Marks : 80

N.B. :— All questions are compulsory and carry equal marks.

EITHER

1. (a) Explain first order and second order Zeeman Effect using perturbation theory. 8

   (b) Show that shift in energy of perturbed degenerate levels are given by secular determinant. 8

OR

   (p) An hydrogen atom in the first excited state is placed in a uniform electric field E along the positive z-axis. Evaluate correction in the energy, and hence draw energy level diagram. 8

   (q) Discuss time independent perturbation theory for the non-degenerate case. 8

EITHER

2. (a) Derive the Fermi Golden rule for the transition rate from a given initial state to a final state of continuum. 8

   (b) Show that the first order effect of a time dependent perturbation, varying sinusoidally in time, lead to emission or absorption of energy. 8

OR

   (p) Show that transition probabilities of absorption and induced emission between any pair of atomic states are the same. 8

   (q) Explain forbidden transition by giving suitable examples. 8

EITHER

3. (a) What are partial waves ? What is significant number of partial waves. 4

   (b) Calculate the scattering cross-section for a low energy particle from a potential given by

   $V_{(r)} = -V_0$ for $r < a$

   $V_{(r)} = 0$ for $r > a$,

   using Born approximation. 6

(c) Obtain an expression for total scattering cross-section for ℓ^{th} partial wave by a perfectly rigid sphere. 6

OR

(p) Explain the significance of the phase shift in the scattering cross-section of a spherically symmetric potential. 4

(q) Show that a plane wave is equivalent to the superposition of number of spherical waves. 6

(r) Define total scattering cross-section and differential scattering cross-section and obtain the relation between scattering cross-sections in L-system and C-system. 6

EITHER

4. (a) Explain the algebra of creation and annhialation operators for integral spin particles. 7

(b) Construct symmetric and antisymmetric wavefunctions for two particle and three particle systems. 6

(c) What are symmetric and antisymmetric wavefunctions ? 3

OR

(p) Explain the algebra of creation and annihilation operators for Fermions. 7

(q) What is the general representation of one and two particle operators in creation and annihilation operator algebra. 6

(r) Show that symmetric character does not change with time. 3

EITHER

5. (a) Discuss the properties of Dirac's Matrices. 4

(b) Explain the semi classical theory of radiation. 6

(c) Derive Dirac's relativistic wave equation. 6

OR

(p) Obtain covariant form of K.G. Equation. 4

(q) Show that spinning motion of electron is natural outcome of the Dirac's Equation. 6

(r) Obtain continuity equation corresponding to Dirac's equation. 6