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

(c) Write Dirac's matrices. 2

OR

(p) Derive Dirac's relativistic wave equation. Obtain the continuity equation corresponding to Dirac's equation. 8

(q) Obtain covariant form of Klein-Gordan equation. 6

(r) Show that $[\alpha_x \alpha_y \alpha_z \beta, \beta] = 2\alpha_x \alpha_y \alpha_z$. 2

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

PHYSICS

Paper—2-PHY-2

(Quantum Mechanics—II)

Time : Three Hours] [Maximum Marks : 80

EITHER

1. (a) Develop the stationary perturbation theory for nondegenerate case up to first order. 8

(b) A 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. Draw an energy level diagram illustrating the different states in the presence of the field. 8

OR

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

(q) Explain splitting of spectral lines in weak magnetic field using stationary perturbation theory. 8

EITHER

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

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

OR

(p) On the basis of time dependent perturbation theory, briefly outline the theory of emission and absorption in atomic system. 8

(q) Give the time dependent perturbation theory for the case of perturbation which is constant in time except that it is switched on at t = 0 and switched off at time t. 8

EITHER

3. (a) Show that symmetry character does not change with time. 4

(b) Show that antisymmetric wave function for two Fermions would vanish if both occupy the same position with identical spin. 4

(c) Explain the algebra of creation and annihilation operator for Fermions. 8

OR

(p) Illustrate exchange degeneracy with example. 4

(q) Construct the spin function for three electron system. 4

(r) Explain the algebra of creation and annihilation operator for Bosons. 8

EITHER

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

(b) What is partial wave analysis ? Write and explain mathematical formalism of partial wave analysis method. 6

(c) Explain the method of calculating scattering amplitude by Born approximation method. 6

OR

(p) Discuss the validity condition for Born approximation. 4

(q) Calculate 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 using Born approximation. 6

(r) Solve the hard sphere scattering problem using partial wave analysis. 6

EITHER

5. (a) Develop the Klein-Gordan equation for spin zero particle. Construct the corresponding continuity equation and discuss its non relativistic limit. 8