NOVEMBER/DECEMBER 2018

MPH23 — QUANTUM MECHANICS -II

Time : Three hours Maximum : 75 marks

SECTION A — (5 × 6 = 30 marks)

Answer ALL questions.

All questions carry equal marks.

1. (a) What do you understand by the term scattering cross section? How do you define scattering amplitude? Establish a relation between scattering cross section and scattering amplitude.

Or

(b) Relate the laboratory and centre of mass coordinate system for a Scattering process.

2. (a) Derive the Fermi - Golden rule for constant perturbation that acts for a short interval of time.

Or

(b) Write a short note on selection rules for dipole radiations.

3. (a) What are anti particles? Explain.

Or

(b) Discuss the various implications of negative energy states.

4. (a) What are gamma matrices? Discuss the properties of gamma matrices.

Or

(b) Show that the Dirac matrices are traceless and the eigen values are ±1

5. (a) Enlist the steps of accomplishing second quantization.

Or

(b) What are creation and annihilation operators? Explain.

SECTION B — (3 × 15 = 45 marks)

Answer any THREE questions.

All questions carry equal marks.

6. Outline the method of partial waves and obtain an expression for the total scattering cross section in terms of phase shifts.

7. Discuss briefly the time dependent perturbation theory and derive an expression for the transition probabilities to a group of states per unit time.

8. Obtain the plane wave solutions of the Dirac's equation for free particles. What is the reason for the existence of two positive energy solutions? Explain.

9. Show that Dirac's equation is invariant under Lorentz transformation.

10. Show that Lagrangian of a particle with the charge 'q' moving with the velocity 'V' in an electromagnetic field given by the scalar and vector potentials' φ and 'A' respectively is

$$L=\frac{mv^2}{2}-q\varphi+q \text{ A.V.}$$