K16P 1019

Reg. No. : .....

Name : .....

Third Semester M.A./M.Sc./M.Com. Degree (Reg./Suppl./Imp.) Examination, November 2016

PHYSICS

PHY 3C10 : Quantum Mechanics – II

(2014 Admission Onwards)

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer both questions. (Either **a** or **b**)

1. a) Explain the method of partial waves in scattering problems. Discuss the importance of phase shifts.

   OR

   b) Derive Dirac equation for a free particle. Explain Dirac's matrices.

2. a) Explain the principle of canonical quantization of fields. Discuss how the second quantization leads to Fermi-Dirac statistics.

   OR

   b) Discuss the Einstein's coefficients of spontaneous and stimulated emission of radiation. Derive a relation between A and B coefficients.

(2×12=24)

SECTION – B

Answer **any four**. (**One** mark for part **a**, **3** marks for part **b**, **5** marks for part **c**)

3. a) What do you understand by selection rule.

   b) Explain Fermi's Golden rule.

   c) Calculate the Einstein B coefficient for the $n = 2, l = 1, m = 0 \rightarrow n = 1, l = 0, m = 0$ transition in the hydrogen atom.

P.T.O.

4. a) Define scattering amplitude.

   b) Discuss the validity conditions for Born approximation.

   c) Show that an attractive potential leads to positive phase shifts whereas a repulsive potential to negative phase shifts.

5. a) Write down the wave equation for photon ?

   b) Explain CPT theorem.

   c) Starting from Klein-Gordan equation obtain the equation of continuity.

6. a) Give the Weyl equation for the neutrino.

   b) Discuss the negative energy states if a free Dirac particle.

   c) If $\sigma' = \begin{bmatrix} \sigma & 0 \\ 0 & \sigma \end{bmatrix}$, show that

      i) $\sigma_x'^2 = \sigma_{xy}'^2 = \sigma_z'^2 = 1$

      ii) $[\sigma_x' \alpha_x] = 0$

      where σ is the Pauli matrix and α_x is the Dirac matrix.

7) a) What is second quantization ?

   b) Write a short note on covariance of Dirac equation.

   c) Write a note on Hamiltonian density.

8) a) What do you mean by hidden variables ?

   b) Write a short note in Einstein-Bohr controversy.

   c) Evaluate the scattering amplitude in the Born approximation for scattering by Yukawa potential $V_r = V_0 \exp\frac{-\alpha r}{r}$ where V_0 and α are constants.

(4×9=36)