K21P 1008

Reg. No. : .....

Name : .....

III Semester M.Sc. Degree (CBSS – Reg./Suppl./Imp.) Examination, October 2021
(2018 Admission Onwards)
PHYSICS
PHY3C10 : Quantum Mechanics – II

Time : 3 Hours Max. Marks : 60

SECTION – A

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

1. a) Give the theory of Born approximation in the scattering calculations. Use it to find the cross section for scattering of electrons by nuclei.

OR

b) Develop the time dependent perturbation theory and find the condition for a real transition.

2. a) What do you mean by symmetrical and antisymmetrical wavefunctions ? Discuss the different wavefunctions of two electron helium atom.

OR

b) Explain how the Klein Gordan equation leads to positive and negative probability density values. State the expression for energy of a charged particle obeying Klein Gordan equation in a Coulomb potential. Explain the significance of different terms. **(2×12=24)**

SECTION – B

Answer **any four** questions. (**1** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**).

3. a) State the relation between Einstein's A and B coefficients.

b) What is Laporte selection rule ?

c) Calculate Einstein coefficient B 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) What are partial waves ?
   b) Explain optical theorem.
   c) In a scattering experiment, the potential is spherically symmetric and the particles are scattered at such energy that only s and p waves need be considered. (i) Show that the differential cross section $\sigma(\theta)$ can be written in the form $\sigma(\theta) = a + b \cos\theta + c \cos^2\theta$ (ii) What are the values of a, b, c in terms of phase shifts ? (iii) What is the value of total cross section in terms of a, b, c ?

5. a) What is particle exchange operator ?
   b) Distinguish between fermions and bosons.
   c) What is Slater determinant ? How does it incorporates Pauli's principle ?

6. a) What are Weyl spinors ?
   b) Write a note on second quantization.
   c) Discuss the quantization of Schrodinger equation.

7. a) Give the spin angular momentum of an electron.
   b) Discuss the negative energy states.
   c) Derive the Dirac's relativistic equation for a free particle.

8. a) What is Einstein's locality principle ?
   b) Write a note on delayed choice experiment.
   c) Explain Bell's theorem. **(4×9=36)**
