



K15P 0090

Reg. No. : .....

Name : .....

**Third Semester M.A./M.Sc./M.Com. Degree (Reg./Sup./Imp.)**

**Examination, November 2015**

**PHYSICS (2014 Admn.)**

**PHY3C10 : QUANTUM MECHANICS – II**

Time : 3 Hours

Max. Marks : 60

**SECTION – A**

Answer **both** questions (either **a**) and **b**) :

1. a) Discuss the time dependent perturbation theory. Obtain the Hamiltonian operator for a charged particle in an electromagnetic field.

OR

- b) Discuss the Born approximation. Apply the Born approximation to obtain the Rutherfords scattering formula for scattering by a pure Coulomb potential.

2. a) Develop the Klein-Gordan equation for a spin zero particle. Construct the corresponding continuity equation.

OR

- b) Explain the term second quantization. Discuss the second quantization principle for Bosons. (2×12=24)

**SECTION – B**

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

3. a) Distinguish between stimulated emission and spontaneous emission.  
b) Explain Fermi's Golden rule.  
c) Obtain Einstein's A coefficient for a one dimensional harmonic oscillator of angular frequency in  $n^{\text{th}}$  state.
4. a) Define differential scattering cross-section.  
b) Explain optical theorem.  
c) A particle of mass  $m$  and Energy  $E$  is scattered by a spherically symmetric potential  $A\delta(r - a)$  where  $A$  and  $a$  are constants. Calculate the differential scattering cross-section when the energy is very high.

P.T.O.



5. a) What is a Slater determinant ?  
b) Show that the symmetric character of a wavefunction does not change with time.  
c) Consider two identical fermions both in the spin up state in a 1D infinitely deep well of width  $2a$ . Write down the wavefunction for the lowest energy state.
6. a) Write down the Weyl equation for the neutrino.  
b) Write a short note on Dirac's matrices.  
c) For a Dirac particle moving in a central potential show that the orbital angular momentum is not a constant of motion.
7. a) Distinguish between particle and field.  
b) Explain Lagrangian density.  
c) Write a short note on creation and annihilation operators.
8. a) What do you mean by hidden variables ?  
b) State Bell's theorem.  
c) Explain EPR paradox.
- (4×9=36)

## SECTION - B