



K17P 1349

Reg. No. :

Name :

Third Semester M.Sc. Degree (Reg./Suppl./Imp.)

Examination, November 2017

(2014 Admn. Onwards)

PHYSICS

PHY 3C10 : Quantum Mechanics – II

Time : 3 Hours

Max. Marks : 60

SECTION – A

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

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

OR

- b) Discuss the validity conditions for Born approximation.

2. a) Discuss spin of Dirac particle. Explain the Dirac particle in an electromagnetic field.

OR

- b) Explain second quantization. How does second quantization leads to Bose Einstein and Fermi Dirac statistics. **(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 Laporte selection rule.
c) Calculate the square of the electric dipole transition moment $|\langle 310 | \mu | 200 \rangle|^2$ for Hydrogen atom.

P.T.O.



4. a) What are partial waves ?
 b) Explain Ramsaur-Townsend effect.
 c) Obtain an expression for the phase shift δ_0 for s-wave scattering by the

$$\text{potential } V(r) = \begin{cases} \infty & \text{for } 0 \leq r \leq a \\ 0 & \text{for } r > a \end{cases}$$

Assuming that the scattering is dominated by the $l = 0$ term, show that the total cross-section $\sigma_0 = 4\pi a^2$.

5. a) What is lamb shift ?
 b) Dirac preferred first order equation both in time and space coordinates. Why ?
 c) Explain how Klein Gordon equation leads to positive and negative probability density values.
6. a) What is particle exchange operator ?
 b) Find the eigen value of particle exchange operator and show that it is a constant of motion.
 c) Prove that it is impossible to construct a completely antisymmetric spin function for three electrons.
7. a) Give the wave equation for photon.
 b) What are Pauli spin matrices ?

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

i) $\sigma_x'^2 = \sigma_y'^2 = \sigma_z'^2 = 1$ ii) $[\sigma_x', \alpha_x] = 0, [\sigma_x', \alpha_y] = 2i\alpha_z, [\sigma_x', \alpha_z] = 2i\alpha_y$

8. a) What is Bell's inequality ?
 b) Describe Delayed choice experiment.
 c) Explain EPR paradox.

(4×9=36)