III Semester M.Sc. Degree (CBSS-Reg./Suppl./Imp.)
Examination, October - 2019
(2014 Admission Onwards)
PHYSICS
PHY 3C 10 : QUANTUM MECHANICS - II

Time : 3 Hours   Max. Marks : 60

SECTION - A

Answer both Questions (Either a or b).   (2×12=24)

1. a) Describe the method of partial waves for elastic scattering.

   (OR)

   b) What are Einstein's transition probabilities? Outline the way in which absorption and emission of radiation is explained in quantum mechanics, Explain how the selection rules follow naturally.

2. a) Derive the Dirac's equation for a free particle. Find out the Dirac matrices. Obtain the Dirac equation in covariant form.

   (OR)

   b) Explain the term second quantization. Discuss the second quantization principle for Bosons.

SECTION - B

Answer any **Four**.(1 mark for part a, 3 marks for part b, 5 marks for part c).
                                                        (4×9=36)

3. a) Explain Fermi's golden rule.

   b) Calculate the square of the electric dipole transition moment $|\langle 310|\mu|200\rangle|^2$ for Hydrogen atom.

   c) Discuss electric dipole approximation.

P.T.O.

4. a) Define total and differential scattering cross section.

   b) Explain Optical theorem.

   c) Evaluate the scattering amplitude in the Born approximation, for

      scattering by Yukawa potential $V(r) = \dfrac{V_0 e^{-\alpha r}}{r}$ where V_0 and α are

      constants.

      Show that $\sigma(\theta)$ peaks in the forward direction ($\theta=0$) except at zero energy and decreases monotonically as varies from 0 to π.

5. a) What are spin operators?

   b) Show that σ^2 commutes with each component σ_x, σ_y and σ_z.

   c) Discuss the effect of spin on energy states of helium atom.

6. a) What is first and second quantization?

   b) Discuss the charge conjugation for spin zero particle.

   c) Prove that the operator $c\alpha$, where α stands for Dirac matrix, can be interpreted as the velocity operator.

7. a) What is Lamb shift.

   b) Discuss the Weyl equation for the neutrino.

   c) Starting from Klein Gordon equation, obtain the equation of continuity.

8. a) What is Bell's inequality?

   b) Describe Hidden variables.

   c) Explain EPR paradox.

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