TM243524P

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, NOVEMBER 2024

2023 ADMISSIONS REGULAR

SEMESTER III - CORE COURSE PHYSICS

PH3C09TM20 - Quantum Mechanics – II

Time : 3 Hours **Maximum Weight : 30**

Part A

I. Answer any Eight questions. Each question carries 1 weight **(8x1=8)**

1. Degeneracy is removed by perturbation. Explain
2. Show that variation method gives upper bound to ground state energy.
3. Derive the form of time evolution operator in the interaction picture.
4. Derive the basic coupled differential equation that must be solved to obtain the probability of finding |n> .
5. Distinguish between bosons and fermions.
6. Write down the properties of Dirac matrices.
7. Write down the charge and current densities in Klein-Gordon equation.
8. The dimension of Dirac matrices have to be even. Why ?
9. What is Rutherford scattering?
10. Write a note on scattering length.

Part B

II. Answer any Six questions. Each question carries 2 weight **(6x2=12)**

11. Identify Zeeman effect as a perturbation problem and find out the dominant perturbation term in the Hamiltonian.
12. Determine the ground state energies of harmonic oscillator by variational method.
13. Calculate the differential cross section for absorption process in photoelectric effect.
14. If there are two indistinguishable particles in two different orthogonal and normalized states, show that they tend to be closer together.
15. Show that the Dirac matrices $\alpha_x, \alpha_y, \alpha_z$ and β are unimodular and they anticommute mutually.
16. Derive Klein-Gordon in the Schrödinger form.
17. Explain electric dipole approximation and calculate its absorption cross section.
18. Evaluate the scattering amplitude for Yukawa potential.

Part C

III. Answer any Two questions. Each question carries 5 weight **(2x5=10)**

19. Discuss the time independent perturbation theory for the non-degenerate case and obtain an expression for first order energy.
20. Explain energy shift and decay width in quantum systems in the presence of perturbation.
21. Discuss the total s-wave cross section in hard sphere scattering.
22. Obtain the free particle solution of Dirac equation and explain their significance.