TM253418U

Reg. No :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, OCTOBER 2025

2024 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. Give the principle of variational method.
2. What are the connection formulas in WKB? Why are they needed?
3. Justify the statement electromagnetic wave 'sees' the atom as an electric dipole.
4. Comment on 'detailed balancing'.
5. Distinguish between bosons and fermions.
6. Explain the importance of Klein-Gordon equation.
7. Express Dirac equation in the covariant form.
8. Find the traces of the Dirac matrices (α,β).
9. Give the relation between scattering amplitude and differential cross section.
10. State the reason why higher partial waves may exhibit resonant behaviour.

Part B

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

11. Explain the tunneling effect using WKB method.
12. Apply WKB approximation to find the wave function in the presence of a potential well.
13. Calculate the differential cross section for absorption process in photoelectric effect.
14. Discuss the energy levels of He atom.
15. Show that the Klein-Gordon equation can lead to negative probability density.
16. Verify that probability density and current density defined for Dirac equation satisfy the continuity equation.
17. Discuss harmonic perturbation and derive the rates of absorption and stimulated emission processes.
18. Calculate the differential cross section for Yukawa potential.

Part C

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

19. Outline the principle of WKB approximation and apply the same to find the transmission coefficient for a potential barrier.
20. Derive Fermi Golden rule.
21. Discuss the phase shift analysis for hard sphere scattering.
22. Deduce Dirac wave equation for a charged particle and explain the significance of negative energy states.