QP CODE: 25022307

25022307

Reg No : .....

Name : .....

M.Sc DEGREE (CSS) SPECIAL REAPPEARANCE EXAMINATION, APRIL 2025

Third Semester

M.Sc PHYSICS(MATERIAL SCIENCE)

CORE - PH020303 - ADVANCED QUANTUM MECHANICS

2019 ADMISSION ONWARDS

437A26A9

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Prove that evolution of interaction picture state ket is determined by perturbing potential V_i
2. What is meant by Dyson series?
3. Discuss adiabatic approximation.
4. Define hard sphere potential.
5. What is Resonance scattering?
6. Explain the need of relativistic quantum mechanics.
7. Write the expression for probability density and probability current density in the Dirac formalism.
8. Is Dirac equation Lorentz invariant? Elucidate.
9. Show that the annihilation operators commute with each other.
10. Write down the Hamiltonian for a Dirac field and show that if commutation relation between the field operators are followed it won't be a positive definite.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Show that it is possible to study the emission or absorption of radiation by subjecting the system to a harmonic perturbation. Explain.
12. Using time dependent perturbation theory prove that the probabilities for finding the initial state and all other states add up to 1

13. Show that the scattering amplitude bears a relation with scattering cross section.

14. Discuss the Born approximation and comment on its validity.

15. Give an account of 'Thomas term'. Elaborate its significance.

16. What are gamma matrices? Explain their properties.

17. What is meant by Lagrangian density? Why is it necessary to define this quantity in the Lagrangian formulation of classical field theory?

18. Define functional derivative. Express the Lagrangian field equation in terms of it.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Discuss sudden and adiabatic approximation in detail.

20. Apply the partial wave method to study the scattering by a square well potential. Explain the phenomenon of resonance.

21. Derive the Dirac equation and express it in covariant form. Show that the total angular momentum of a Dirac particle is a constant of motion.

22. Explain the quantization of Klein-Gordon field.

(2×5=10 weightage)