

KAMARAJ COLLEGE (Autonomous)

Accredited with A+ Grade by NAAC

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

THOOTHUKUDI – 628 003

(5 Pages)

Reg. No:

Question Code No : 25003301

Sub Code : 24PMPH31

PG Degree - End Semester Examinations, November 2025

Third Semester

M.Sc. PHYSICS

Quantum Mechanics II

(For those who joined in July 2024 onwards)

Time : 3 Hours

Maximum : 75 Marks

PART A – (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

1. The unit of differential scattering cross-section is
 - (a) length
 - (b) $\sqrt{\text{length}}$
 - (C) $(\text{length})^2$
 - (d) $(\text{length})^3$
2. The optical theorem relates the total cross-section and the imaginary part of

- (a) Time (b) Scattering amplitude
(c) Charge (d) None of the above
3. In the given relation $H=H^0+H'$ which is unperturbed Hamiltonian
(a) H (b) H'
(c) H^0 (d) None of the above
4. Fermi's Golden rule relates the ω and
(a) $\rho(E)$ (b) ρ^3
(c) ρ^2 (d) ρ^4
5. What is the dimension of Dirac matrix?
(a) Odd (b) Even
(c) Sometimes odd (d) Sometimes even
6. The antiparticle of electron is
(a) Positron (b) Antineutrino
(c) Neutrino (d) Proton
7. The γ matrices are
(a) Hermitian (b) Invariant under Lorentz transformation
(c) Anti commute (d) All the above
8. Find the trace of the given matrix $\beta=\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
(a) 1 (b) 4

(C) 2

(d) 3

9. For the system of fermions the value of $N_k =$

(a) 0

(b) 1 or 0

(C) 1

(d) 2

10. The number operator N_k is represented as

(a) $aa^\dagger$

(b) a

(c) $a^\dagger$

(d) a^*

PART – B (5 X 5 = 25 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 250 words.

11. (a) Discuss about Yukawa potential.

(OR)

(b) What is the condition of validity of Born approximation?

12. (a) Discuss about harmonic perturbation.

(OR)

(b) Outline adiabatic approximation.

13. (a) Derive an expression for Klein -Gordon equation.

(OR)

(b) Write about negative energy states.

14. (a) Write any four properties of γ matrices.

(OR)

(b) Describe the covariant form of Dirac equation.

15. (a) Write about Lagrangian density.

(OR)

(b) Derive an expression for creation and annihilation operators.

PART – C (5 X 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 600 words.

16. (a) Discuss about scattering by screened Coulomb potential.

(OR)

(b) Explain the method of partial wave analysis in scattering theory.

17. (a) Outline Sudden approximation.

(OR)

(b) Describe the selection rules for dipole radiation.

18. (a) Find the plane wave solution to the Dirac equation.

(OR)

(b) Explain the spin of electron based on Dirac theory.

19. (a) Derive an expression for probability density.

(OR)

(b) Explain Feynman's theory of positron.

20. (a) Derive an expression for classical field equation.

(OR)

(b) Derive Euler- Lagrange equation.