KAMARAJ COLLEGE (Autonomous)

Accredited with A+ Grade by NAAC

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

(3 Pages) **Reg. No:……**

Question Code: 26O03304 **Course Code : 24PMPH31**

PG Degree - End Semester Examinations, November 2026

Third Semester

M.Sc. PHYSICS

Quantum Mechanics-II

(For those who joined in July 2024 onwards)

Time : 3Hours **Maximum : 75 Marks**

PART – A (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

CO:1 K:1 1. For the Yukawa potential, the parameter μ determines the

(a) Particle mass (b) Scattering Length

(c) Charge of Particle (d) Angular Momentum

CO:1 K:2 2. The differential cross-section for a central potential depends only on

(a) Azimuthal angle (b) Time

(c) Polar scattering angle (d) Spin only

CO:2 K:2 3. Fermi's golden rule is derived using

(a) First order time dependent perturbation theory

(b) Classical mechanics concepts

(c) Thermodynamic concepts

(d) Special theory of relativity

CO:2 K:1 4. The sudden approximation is essentially the opposite limiting case of the

(a) Born approximation (b) WKB approximation

(c) Adiabatic approximation (d) Variational approximation

CO:3 K:1 5. The Klein-Gordon equation is

(a) First order in time (b) Second order in time

(c) Zeroth order in time (d) Third order in time

CO:3 K:2 6. The positive energy solutions corresponds to

(a) E<0 (b) Imaginary energy

(c) E=0 only (d) E>0

CO:4 K:2 7. The Dirac equation is constructed to be invariant under

(a) Lorentz transformations (b) Galilean transformations

(c) Rotations only (d) Translations only

CO:4 K:1 8. The Zeroth component of the current is related to

(a) Probability density (b) Momentum

(c) Spin only (d) Mass

CO:5 K:1 9. The Euler–Lagrange equation follows from the principle of

(a) Least energy (b) Least momentum

(c) Stationary action (d) Conservation of charge

CO:5 K:2 10. The annihilation operator changes the occupation number by

(a) +1 (b) -1

(c) +2 (d) 0

PART – B (5 X 5 = 25 Marks)

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

Answer should not exceed 250 words.

CO:1 K:1 11. (a) State the Conditions for the Validity of the Born approximation.

(OR)

(b) State and prove the Optical Theorem.

CO:2 K:4 12. (a) Analyze the Time Dependent Perturbation Theory.

(OR)

(b) Compare Sudden and Adiabatic Approximation.

CO:3 K:4 13. (a) Deduce an expression for the Charge and Current Densities of Relativistic Quantum Mechanics.

(OR)

(b) Analyze the Interpretation of Negative Energy States.

CO:4 K:3 14. (a) List out the Properties of the gamma Matrices.

(OR)

(b) Identify the Current Four Vectors.

CO:5 K:4 15. (a) Analyze the equation of Hamiltonian formulation.

(OR)

(b) Simplify the Second Quantization of K-G field.

PART – C (5 X 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).
Answer should not exceed 600 words.

CO:1 K:5 16. (a) Explain about the Scattering by a Screened Coulomb Potential.

(OR)

(b) Explain the Method of Partial Wave Analysis in Scattering Theory.

CO:2 K:6 17. (a) Elaborate the theory of the equations of Einstein's A and B Coefficients.

(OR)

(b) Discuss about Semi – Classical Treatment of an Atom with Electromagnetic Radiation.

CO:3 K:4 18. (a) Derive an Expression for Klein -Gordon Equation.

(OR)

(b) Analyze the Anti-Particles and Spin of Electron based on Dirac Theory.

CO:4 K:5 19. (a) Deduce an Expression for Probability Density.

(OR)

(b) Explain about the Feynman's theory of Positron.

CO:5 K:6 20. (a) Discuss about the Quantization of Real and Complex Scalar Fields.

(OR)

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