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(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2023-24 ONLY)

SUBJECT CODE 23 PPS 309

REG.NO.

**N.G.M.COLLEGE (AUTONOMOUS): POLLACHI**

**END-OF-SEMESTER EXAMINATIONS: NOVEMBER – 2024**

**M.Sc. – PHYSICS** **MAXIMUM MARKS: 75**

**SEMESTER: III** **TIME: 3 HOURS**

# QUANTUM MECHANICS – II

## SECTION – A (10 X 1 = 10)

**ANSWER THE FOLLOWING QUESTIONS. (K1)**

1. Born approximation for phase shift is valid for

   a) partial wave analysis b) scattering by coulomb potential
   c) only for weak potentials d) valid only for strong potentials.

2. Einestein coefficient for spontaneous emission is (n- lower state, m- upper state)

   a) $A_{nm}$ b) $B_{nm}$ c) $A_{mn}$ d) $B_{mn}$.

3. The square of a Pauli spin matrix is

   a) Unitary matrix b) diagonal matrix c) Unity d) zero

4. Quantum field theory is also referred as

   a) Quantum electrodynamics b) Lagrangian quantization
   c) First Quantization d) Quantization of energy momentum

5. In Thomas –Fermi model the electrons are treated as

   a) particle b) gas c) many electrons d) energy units

**ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES. (K2)**

6. What is the dimension of total scattering cross-section?

7. Name the type of perturbation when a molecule exposed to electromagnetic radiation.

8. What are spinors?

9. What is Second quantization ?

10. In which method the many electron wave function is simply a product of one-electron wave functions.?

## SECTION – B (5 X 5 = 25 MARKS)

**ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)**

11. a) Define the term " differential scattering cross section"and deduce the expression for the total cross section.

**(OR)**

b) What is Born approximation? Derive the expression for scattering amplitude $f(\theta)$.

12. a) Give the semi classical theory of electromagneti radiation.and deduce the expression for energy density..

**(OR)**

b) What is known as dipole approximation? Discuss its role in selection rules.

**(CONTD …. 2)**

13. a) Deduce the KG equation and show that it is invariant..

**(OR)**

b) Obtain Dirac α and β matrices from relativistic Hamiltonian.

14. a) Elucidate "Quantization of the field"

**(OR)**

b) Discuss the utility of creation and destruction operators in field quantization.

15. a) Write a note on hydrogen like orbitals.

**(OR)**

b) What is the role of Hartee -Fock in many electron system?

**SECTION – C (5 X 8 = 40 MARKS)**

**ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.**

**(K4 (Or) K5)**

16. a) What is partial wave analysis? Derive the expression for scattering amplitude through it.

**(OR)**

b) Derive the Rutherford's scattering formula through scattering by screened coulomb potential.

17. a) What are Einestein coefficients? Obtain the expression for spontaneous and stimulated transitions and prove that spontaneous emission increased as the cube of transition frequency.

**(OR)**

b) What is Raman scattering? Approach this phenomenon through time dependent perturbation and deduce the expression for dipole moment associated with transitions.

18. a) Obtain the plane wave solution for the Dirac's equation.

**(OR)**

b) Derive the expression for the energy eigen values of hydrogen atom using radial equation for an electron in a central potential.

19. a) Deduce the classical field equations in Hamiltonian form.

**(OR)**

b) Give the theory of quantization of Schrödinger equation and deduce the appropriate quantum field equations

20. a) Obtain the expression for the bound states of hydrogen atoms

**(OR)**

b) Apply Hartee method to obtain the expression for self consistent potential

***ETHICAL PAPER***

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