

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2023
(Second Semester)

Branch - PHYSICS

QUANTUM MECHANICS II

Time: Three Hours

Maximum: 50 Marks

SECTION-A (5 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(5 x 1 = 5)

- 1 The stimulated emission can be made to predominate over absorption process by achieving ----- between two levels.
(i) transition (ii) Completeness
(iii) stimulated emission (iv) Population Inversion
- 2 In some scattering process the energy of the incident particle does not change. Such scattering are called .
(i) Elastic scattering (ii) Inelastic scattering
(iii) differential scattering (iv) total scattering
- 3 The condition for self-consistency is that the----- must be consistent with the initially chosen ones.
(i) Probability density (ii) current density
(iii) Charge density (iv) density of states
- 4 The empty space in the midst the of the negative energy states is called _____.
(i) energy gap (ii) spinors
(iii) Hole (iv) forbidden gap
- 5 The quantisation of field is called-----.
(i) first quantization (ii) quantum field
(iii) third quantization (iv) second quantization

SECTION - B (15 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(5 x 3 = 15)

- 6 a Explain the three level laser scheme.
OR
b Differentiate between Induced Emission and spontaneous emission.
- 7 a Discuss Rutherford Scattering formula.
OR
b Explain the Complex potential.
- 8 a Discuss Hartee's self consistent method for determining potential energy $V(r)$ in central field approximation.
OR
b Explain the hydrogen molecule using variational method.

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- 9 a. Obtain Klein Gordan relativistic wave equation.
OR
b. Obtain the Dirac equation of a free particle.
- 10 a. Explain the term second quantization.
OR
b. Describe the creation, and Annihilation operators.

SECTION -C (30 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks

(5 x 6 = 30)

- 11 a Explain the electric dipole transition with the selection rules and their origin.
OR
b Obtain the relationship between Einstein coefficients A and B.
- 12 a Discuss the Born approximation and also discuss the validity conditions for the same.
OR
b Discuss the partial wave method of determining the scattering process.
- 13 a Find an expression for electron density in Fermi-Thomas model and show that the radius of the sphere enclosing a fixed fraction of all electrons is proportional to $Z^{-1/3}$.
OR
b Discuss the general theory of Variational principle. Show that this principle can be used to obtain the ground state of Helium atom.
- 14 a Explain the Dirac electron has spin $\frac{1}{2}$.
OR
b Summarize the properties of Dirac Matrices and hence determine them.
- 15 a Explain the meaning of number representation. Also obtain the quantized form of Hamiltonian of the Dirac Field. Discuss the result.
OR
b Quantize the non relativistic Schrodinger equation for bosons of mass m moving in a potential field.

Z-Z-Z

END