

PSG COLLEGE OF ARTS & SCIENCE  
(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2022  
(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. Identify the selection rules for semi electrical transition from the following
  - a.  $\Delta l = \Delta m = 0, \Delta s = 0$
  - b.  $\Delta l = \Delta m = +1, \Delta s = 0$
  - c.  $\Delta l = \Delta m = -1, \Delta s = 0$
  - d.  $\Delta l = \Delta m = \pm 1, \Delta s = 0$
2. The Green's function is essentially the inverse of the \_\_\_\_\_
  - a. differential operator
  - b. Hamilton operator
  - c. Energy operator
  - d. delta function
3. The pionic atom is a system consisting of a \_\_\_\_\_
  - a. Pion and a neutrino
  - b. Double pion
  - c. Muon
  - d. pion and an atomic nucleus
4. Which of the following option is not correct for the statement given below:  
In this central-field approximation
  - a. each electron moves independently of the other electrons in the atom in a spherically -symmetric average field
  - b. the potential is spherically symmetric
  - c. the central part of the electron-electron interaction is included
  - d. the potential is spherically Asymmetric
5. Choose the correct answer  
quantum field theory, particles are described by quantum fields which satisfy the .
  - a. Dirac equation
  - b. Schrödinger equation
  - c. Einstein equation
  - d. commutation relations

SECTION - B (15 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks (5 x 3 = 15)

- 6 a Explain the various LASER emission schemes.  
OR  
b Outline the working principle of MASERS.
- 7 a Analyze the Born approximation in scattering theory.  
OR  
b Discuss the scattering cross section and optical theorem.
- 8 a Explain the properties of the Dirac electron.  
OR  
b Derive the Klein Gordan equation.
- 9 a Outline the basic concepts of Hartees self consistent field model.  
OR  
b Derive the energy of the muonic atom.
- 10 a Explain the poisson braket formulation of field variables.  
OR  
b Narrate about the create and annihilation operator of quantum energy.

**SECTION -C (30 Marks)**

Answer **ALL** questions

**ALL** questions carry **EQUAL** Marks

(5 x 6 = 30)

11 a Analyze the transition probabilities per second in semi classical treatment using dipole approximation.

OR

b Outline the relation between Einstein coefficients.

12 a Obtain the scattering amplitude of a particle by using partial wave analysis method.

OR

b Enumerate the theory of scattering by square well potential.

13 a Show that the orbital angular momentum is not a constant of motion for Dirac particle moving in a central potential.

OR

b Discuss the Lorentz transformation operator.

14 a Discuss the variational method and also calculate the ground state energy of Helium atom using the same.

OR

b Discuss the Heitler and London theory of hydrogen molecule.

15 a Examine the Lagrangian formulation of the central force field.

OR

b Elucidate the quantization of non relativistic wave equation.

Z-Z-Z

END