I Semester Examination, April-2021

M.Sc.

PHYSICS

Paper III

(Basic Quantum Mechanics)

Time : 3 Hours]   [Maximum Marks : 80

Note : *All questions are compulsory. Question Paper comprises of 3 sections. **Section A** is objective type/Multiple Choice questions with no internal choice. **Section B** is short answer type with internal choice. **Section C** is long answer type with internal choice.*

SECTION 'A'
(Objective Choice Questions)

Give the correct answer :   **1 × 8 = 8**

1. The expression for probability current density is……………

2. The completeness condition for eigen function is……………

3. The dimensions of Hilbert space depend on …………

4. The condition for an operator to be unitary in…………

5. …………is an operator for infinitesimal rotation.

6. X-component of Pauli's spin Matrices σ_x in matrix from can be written as …………

7. For a centrally symmetric potential, the total solution of angular part of Schrodinger equation can be expressed by a special function.

8. The perturbed Hamiltonian for Stark effect is…………

SECTION 'B'   6 × 4 = 24
(Short Answer Type Questions)

Note : *Answer the following questions in 250 words.*

1. Explain photoelectric effect using Planck's quantum theory.

Or

Explain Davison-Germer experiments and its outcomes.

2. Solve the Schrodinger equation for periodic potential well.

Or

Obtain equation of motion in Heisenberg picture.

3. Describe Stern-Gerlach experiment and its outcome.

Or

Obtain commutation relation beween I+ and I– operators.

4. Express how to simplify a two body problem using center of mass frame.

Or

Obtain an expression for first order change in energy using time independent pertubation theory.

SECTION 'C'   12 × 4 = 48
(Long Answer Type Questions)

Note : *Answer the following questions in 500 words.*

1. What is Compton effect ? How does it explain the particle nature of radiation.

Or

What is a wave packet ? Obtain an expression for Gaussian wave packet.

2. Solve Schrodinger equation for periodic potential well.

Or

Describe various representations and their transformations using unitary operators U,V and W.

3. Obtain eigen values and eigen functions of angular momentum operators.

Or

Obtain expressions for Pauli's spin matrices and write their characteristic properties.

4. Describe Time independent perturbation theory for a Harmonic oscillator.

Or

Solve Schrodinger equation for first order Stark effect in Hydrogen.

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