Total Pages : 3 **Roll No. ....**

MSCPH-512

M.Sc. Physics (MSCPH)

Advanced Quantum Mechanics

Examination February, 2026

Time : 2:00 Hrs. Max. Marks : 70

Note* :–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

Section–A

(Long Answer Type Questions) (2×19=38)

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. Give the theory of Born approximation in the scattering. Use it to find the Rutherford's scattering cross section formula.

2. Derive the semi-classical treatment of matter-radiation interaction for an atom in a plane electromagnetic wave. Obtain the transition rates and selection rules for electric dipole transitions.

3. Derive Dime's relativistic wave equation. Obtain spin and magnetic moment of electron using Dime's relativistic theory.

4. Describe identical particles and exchange degeneracy. Discuss Schwinger's action principle.

5. Describe quantization of the Schrodinger equation for non relativistic domain and formalize it for system of Bosons.

Section–B

(Short Answer Type Questions) (4×8=32)

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. Explain Phase shift in scattering process and obtain Optical theorem.

2. Give some applications of time-dependent perturbation theory.

3. Explain the sudden approximation with a derivation of the transition probability. Compare it briefly with the adiabatic approximation.

4. Construct continuity equation using Klein-Gordon equation. Discuss it's validity in brief.

5. Discuss magnetic moment of an electron due to spin.

6. Derive the exchange degeneracy for two non-interacting identical particles in a harmonic oscillator potential.

7. Show that the fermionic anticommutation rules among the creation and annihilation operators verify the Pauli Exclusion principle.

8. Obtain expression for Hamiltonian density.

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