



APRIL/MAY 2019

MPH13 — QUANTUM MECHANICS - I

Time : Three hours

Maximum : 75 marks

SECTION A — (5 × 6 = 30 marks)

Answer ALL questions.

1. (a) Explain the normalization condition and the various admissibility conditions on the wave function.

Or

- (b) State any two properties of Hermitian operators and prove them.

2. (a) Formulate the Schrodinger's equation for a particle in a box. Solve it to obtain eigen functions and show that the eigen values are discrete.

Or

- (b) Explain how the wave equation of a system of two particles is reduced into two one-particle equations.



3. (a) Explain the Dirac's notations.

Or

- (b) Arrive at the time development of state vector in Schrodinger picture.

4. (a) Prove that for ground state of hydrogen, there is no first order stark effect.

Or

- (b) Obtain the energy levels of a linear harmonic oscillator by WKB approximation method.

5. (a) Obtain the non-relativistic Hamiltonian including the spin of electron.

Or

- (b) Derive the commutation relations for L and its components.

SECTION B — (3 × 15 = 45 marks)

Answer any THREE questions.

6. State and explain the postulates of quantum mechanics.
7. Explain how one can solve the problem of hydrogen atom quantum mechanically and obtain the energy eigen functions and the corresponding eigen values.

8. Discuss the conservation laws associated with (a) space inversion symmetry and (b) time reversal symmetry.

9. Explain the variation method and use it to obtain an upper limit for the ground state energy of the helium atom.

10. Calculate the C-G coefficients for  $j_1 = \frac{1}{2}$ ,  $j_2 = \frac{1}{2}$  and  $j_1 = 1$ ,  $j_2 = \frac{1}{2}$ .

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