

35071

M.Sc. DEGREE EXAMINATION, OCTOBER/NOVEMBER 2019.

THIRD SEMESTER

Physics

Paper – I : QUANTUM MECHANICS – I

Time : Three hours

Maximum : 75 marks

(No additional sheet will be supplied)

PART A — (5 × 3 = 15 marks)

Answer any FIVE questions.

Each question carries 3 marks.

Each answer should not exceed 1 page.

1. Define Unitary Operator and explain Unitary transformation.
2. Explain Kroniker Delta and Dirac Deltas Functions.
3. Write the proterties of Commutation brackets.
4. Obtain eigen values for simple harmonic oscillator by abstract operator method.
5. Explain first order Stark effect of a plan rotator.
6. Write the connecting formulae across the classical turning points.
7. Explain the Quantum theory of scattering.
8. What is Green's function and explain its significance in scattering theory.

PART B — (4 × 15 = 60 marks)

Answer ALL questions.

Each question carries 15 marks.

Each answer should not exceed 6 pages.

9. Write the postulates of Quantum Mechanics. Describe quantum mechanical tunneling through a step barrier and obtain transmission and reflection coefficients for  $E > V_0$  in single step barrier.

Or

10. Write the properties of Hermitian operators and explain their significance in quantum mechanics. Show that Hermitian operator have real eigen values. Give the matrix theory of a linear Harmonic oscillator.
11. Obtain the equation of motion of operators in Heisenberg picture and explain the equivalence of various pictures.

Or

12. Obtain eigen functions and eigen values for a free particle in three dimensional infinitely deep potential well.
13. Discuss the time independent perturbation theory for a non-degenerate stationary system and obtain the first order corrected eigen functions and energy eigen values. Calculate the energy eigen values corrected up to first order perturbation for a He atom.

Or

14. Discuss the time dependent perturbation theory and obtain an equation for finding the probability of particle in  $m^{\text{th}}$  state. Explain transition to the continuum and obtain Fermi Golden rule.
15. Discuss the method of partial waves to explain scattering phenomena and obtain an equation for scattering cross-section. What is optical theorem and explain its significance.

Or

16. Explain the scattering theory using Born approximation method and derive an equation for scattering cross-section. Explain the validity of Born approximation.

