

Class – B.Sc. IV  
Subject – Physics

Paper – A (Quantum Mechanics)

Time Allowed : 3 Hours

Maximum Marks : 35

The candidates are required to attempt ONE question each from Section B, C, D and E. **Section A** consisting of **Seven** short answer type questions is compulsory. All questions carry equal marks.

Section A

Q1. Attempt all parts:

- (i) Why is the wave nature of matter not more apparent to us in our daily observations?
- (ii) What do you understand by the term work function?
- (iii) What is the condition for orthogonal wave function?
- (iv) What is Raman effect
- (v) What is Auger effect?
- (vi) Explain the term degeneracy.
- (vii) What are eigen functions and eigen value?

Section - B

- Q2.(a) Define phase velocity of a de broglie wave. Show that phase velocity can exceed the velocity of light in vacuum. 5
- (b) A particle is described by a wave function

$$\psi = \sqrt{\frac{2}{L}} \sin \frac{n \pi x}{L} \text{ for } 0 < x < L \text{ and } = 0 \text{ else where.}$$

Find expectation value of momentum of the particle.2.

Q.3(a) By using Heisenberg's uncertainty principle, explain.

- (1) Non-existence of electrons within nucleus.
- (2) Existence of finite zero point energy. 5
- (b) What are the conditions for a wave function to be called well behaved wave function? 2

### Section - C

- Q 4. Define Hermitian operator. Prove that Hermitian operator has real Eigen value. Define orthogonal wave functions. Prove that two Eigen functions of hermitian operator belonging to different Eigen values are orthogonal. 7
- Q 5. State and explain Ehrenfest's theorem on the motion of wave packets. 7

### Section D

- Q 6. Solve schrodinger equation for one dimensional harmonic oscillator to obtain its energy levels. What is zero point energy of Harmonic oscillation. Explain.
- Q 7. A particle of mass M and total energy E moves from the region of zero potential to the region of constant potential  $V_0$ . Given that  $E > V_0$  derive expressions for reflection coeff R and transmission Coeff T. Prove that  $R + T = 1$ . 7

Section E

- Q 8. Give the origin of continuous and characteristic X ray spectra. Why is characteristic spectra so called? 7
- Q 9. Obtain an expression for rotational energy levels in diatomic molecule and frequency rotational spectrum. State clearly the selection rules. Show that in rotational spectra the frequencies are equally spaced. 7