Duration : 180 Minutes
Max Marks : 100

Sem V - C1UD502B - Quantum Mechanics and Spectroscopy

General Instructions
Answer to the specific question asked
Draw neat, labelled diagrams wherever necessary
Approved data hand books are allowed subject to verification by the Invigilator

1) List the difference between x rays and visible light. — K1 (2)

2) Estimate the minimum uncertainty when the uncertainty in measuring velocity of a proton is $8 \ X \ 10^4$ m/s. — K2 (4)

3) Show how $V_p \ X \ V_g = C^2$ where Vp phase velocity, V_P is the group velocity and C is the velocity of light. — K2 (6)

4) Analyze the expression for frequency of linear harmonic oscillator and obtain the frequency. — K3 (9)

5) Analyze the X-ray absorption in detail. — K3 (9)

6) The dispersion relation for free relativistic electron waves is — K5 (10)

$$\omega = \sqrt{c^2 \kappa^2 + \left(mc^2 / \hbar\right)^2}$$

(a) Determine the expressions for the phase velocity u and group velocity vg of these waves and show that their product is constant, independent of ?
(b) From the result (a), what can you conclude about v_g if u > c?

7) Analyze the quantum numbers associated with the vector model of the atom. — K4 (12)

8) A particle of mass m is in the state, Evaluate the value of A, <x> and $<p_x>$ — K5 (15)

$$\Psi(x,t) = Ae^{-a[(mx^2/\hbar)+it]}$$

9) A particle of mass m is in the state, Discuss the value of A and $< x >^2$ — K5 (15)

$$\Psi(x,t) = Ae^{-a[(mx^2/\hbar)+it]}$$

10) Describe the Stern – Gerlach Experiment using principle, theory and experimental procedure. — K6 (18)