Exam. Code : 103204
Subject Code : 1305

B.A./B.Sc. 4th Semester

PHYSICS (Quantum Mechanics)

Paper—A

Time Allowed—Three Hours] [Maximum Marks—35

Note :— The candidates are required to attempt **ONE** question each from Sections B, C, D and E. Section A consisting of **SEVEN** questions is compulsory. All questions carry equal marks.

SECTION—A

1. (a) Explain why Compton shift is not observed with visible light ?

   (b) Why wave nature of matter is not apparent in our daily observations ?

   (c) What are eigenvalues and eigenfunctions ?

   (d) What is zero point energy of an oscillator ?

   (e) Why do we express Schrodinger equation for hydrogen atom in spherical polar coordinates ?

   (f) Calculate the wavelength of X-rays produced when the potential difference applied is 12285 volts. Given $h = 6.6 \times 10^{-34}$ joule-sec, $e = 1.6 \times 10^{-19}$ C and $C = 3 \times 10^{8}$ m/s.

   (g) What is the importance of Raman effect ?

   $7 \times 1 = 7$

SECTION—B

2. Discuss an example of position momentum uncertainty and hence verify Hesinberg's uncertainty principle. 7

3. Explain laws of photoelectric effect. Derive Einstein's photoelectric equation. Also explain photoelectric effect from Einstein's equation. 7

SECTION—C

4. Prove that the expectation value of position and momentum for a wave packet is given by :

$$\frac{d}{dt}\langle x\rangle = \langle V_x\rangle \text{ and } \frac{d}{dt}\langle P_x\rangle = \left\langle -\frac{\partial V}{\partial x}\right\rangle .$$

2×3.5=7

5. Prove that expectation values of dynamical quantities represented by Hermitian operator are always real. 7

SECTION—D

6. Discuss quantum mechanically the motion of particle in a box. Find different eigenfunctions and eigenvalues. Show that both energy and momentum are quantised. 7

7. Discuss physical significance of various quantum numbers. 7

SECTION—E

8. What are two types of X-ray spectra ? Explain the mechanism of production of continuous X-ray spectra. 7

9. Obtain expression for energies and frequencies of various rotational levels of diatomic molecule along with selection rules. 7