(i) Printed Pages : 3   Roll No. ....

(ii) Questions : 7   **Sub. Code :** | 1 | 7 | 2 | 4 | 9 |

                            Exam. Code : | 0 | 0 | 0 | 3 |

B.A./B.Sc. (General) 3rd Semester
(2124)
PHYSICS
Paper : C : Quantum Physics-I

Time Allowed : Three Hours]   [Maximum Marks : 44

Note :— (1) Attempt **FIVE** questions in all, selecting **TWO** from each Unit-I and II. Question No. 7 (Unit-III) is compulsory.

         (2) Use of Non-programmable calculator is allowed.

UNIT—I

1. What is Compton effect ? Why this effect can't be explained on the basis of classical theory ? Explain this effect with the help of quantum theory and find the expression of Compton shift and kinetic energy of recoil electron.   9

2. (a) State and prove Heisenberg's uncertainty principle.

     (b) The photoelectric threshold of tungsten is 2300 A⁰. Determine the energy of electrons ejected from the surface by UV light of wavelength 1800 A⁰.

     (c) What is Pair Production ? Why can't a photon of energy less than 1.02 MeV give pair production ?   5,2,2

3. (a) State and prove Ehrenfest theorem.

    (b) A particle is moving in one dimensional box and its wave function is given by :

    $$\psi(x) = \begin{cases} A \sin \pi x / a & \text{for } 0 < x < a \\ 0 & \text{outside} \end{cases}$$

    Normalize the wave function.   6,3

UNIT—II

4. A particle of mass m and energy $E < V_0$ travelling along x-axis reaches a potential barrier defined as :

    $$V(x) = \begin{cases} 0 & \text{for} & x < 0 \\ V_0 & \text{for} & 0 < x < a \\ 0 & \text{for} & x > 0 \end{cases}$$

    Find expression for reflection and transmission coefficients. 9

5. (a) Derive an expression for energy of a harmonic oscillator. What do you understand by zero point energy ?

    (b) Explain the concept of degeneracy of energy levels. 7,2

6. (a) Derive Schrodinger equation for Hydrogen atom using spherical coordinates.

    (b) Explain the physical significance of magnetic quantum number.   7,2

UNIT—III

7. Attempt any **eight** parts :

    (a) Draw a graph showing variation of stopping potential with incident frequency in case of photoelectric effect.

    (b) What is de-Broglie wavelength of an electron which has been accelerated from rest through a potential difference of 28.8 V ?

· (c) Give the expressions of momentum and energy operators.

(d) Photon has zero rest mass. Explain.

(e) What is Bragg's law ?

(f) What is the range of r, 0 and ϕ in spherical polar coordinates ?

(g) What is a Hamiltonian operator ?

(h) On what principle does an electron microscope work ?

(i) How is group velocity related to phase velocity ?

(j) The surface temperature of hot body is 1227°C. Find the wavelength at which it radiates maximum energy. Given $b = 28.28 \times 10^{-4}$ mK. $\quad\quad\quad$ 1×8=8