

Roll No. ....

Total No. of Questions : 9]  
(2041)

[Total No. of Printed Pages : 4

**UG (CBCS) IIIrd Year (Annual)  
Examination**

**2526**

**B.Sc. PHYSICS**

(Elements of Modern Physics)

(DSE-1A)

Paper : PHYS 301 TH

**Time : 3 Hours]**

**[Maximum Marks : 50**

*Note :-* Attempt *five* questions in all, selecting *one* question from each Sections–B, C, D and E. Question No. 1 (Section–A) is compulsory.

**Section–A**

**(Compulsory Question)**

1. (a) Explain dual nature of material particles.
- (b) Write drawbacks of Rutherford's model of atom.
- (c) What are Eigenvalues and Eigenfunctions ?

- (d) For  $n = 1$ , find the energy of an electron in a box of length  $1 \text{ \AA}$ .
- (e) Find the relation between Electron-volt and Atomic Mass Unit.
- (f) Define the main two units to measure the intensity of radioactivity.
- (g) What is  $\gamma$ -rays Emission ? 2 each

### Section-B

2. (a) What is Compton Effect ? Derive an expression for the wavelength of scattered photon in Compton effect. 4
- (b) Also calculate the expression for the kinetic energy of the recoil electron. 3
- (c) Why is observation of the Compton shift difficult with visible light ? 2
3. (a) Describe Davisson and Germer experiment for the diffraction of electrons. What role did it play in the verification of de-Broglie hypothesis ? 6
- (b) What is de-Broglie wavelength of an electron which has been accelerated from rest through a potential difference of  $100\text{V}$ . 3

**CH-356**

( 2 )



### Section-C

4. (a) Explain Uncertainty Principle. How did Heisenberg show  $\Delta x \cdot \Delta p \geq h/2$  ? Using this principle calculate the binding energy of an electron in hydrogen atom. 6
- (b) An electron has a speed of  $500 \text{ ms}^{-1}$  correct up to 0.01% with what minimum accuracy can you locate the position of this electron. 3
5. (a) Derive the Schrödinger equation for a free particle in one dimension. 5
- (b) Derive an expression for the expectation value of momentum and energy operators. 4

### Section-D

6. 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 coefficient  $R$  and transmission coefficient  $T$ . Prove that  $R + T = 1$ . 9
7. Discuss the semi-empirical mass formula of liquid drop model. 9

### Section-E

8. (a) What do you understand by Half-Life and Mean Life of a radioactive substance ? 6
- (b) The half-life of radon is 3.8 days. After how many days, one per cent of radon will be left behind ? 3
9. Discuss the following terms :
- (a) Nuclear Fuel
- (b) Moderators
- (c) Control Rods
- (d) Coolant 2,3,2,2