

**Faculty of Engineering & Technology**  
**First Semester B.E. (C.B.S.) Examination**  
**ENGINEERING PHYSICS**

Time—Two Hours]

[Maximum Marks—40

**INSTRUCTIONS TO CANDIDATES**

- (1) All questions carry marks as indicated.
- (2) Solve **FOUR** questions as follows :  
Q.No. 1 OR Q.No. 2  
Q.No. 3 OR Q.No. 4  
Q.No. 5 OR Q.No. 6  
Q.No. 7 OR Q.No. 8.
- (3) Assume suitable data wherever necessary.
- (4) Use of Non-programmable electronic calculator is permitted.

**List of Constants :**

Planck's Constant,  $h = 6.63 \times 10^{-34}$  J.S.

Velocity of light,  $c = 3 \times 10^8$  m/s

Charge of electron,  $e = 1.602 \times 10^{-19}$  C

Mass of electron,  $m = 9.11 \times 10^{-31}$  kg

Avogadro's No.  $N_A = 6.023 \times 10^{26}$  atom/Kmol

1. (a) What is Compton effect ? Write expression for Compton shift and explain the existence of modified component and unmodified component in Compton scattering. 4
- (b) What is de-Broglie hypothesis ? Show that de-Broglie wavelength for an electron accelerated by an electric field is  $\frac{12.26}{\sqrt{V}} \text{ \AA}$ . 3
- (c) X-ray photon of wavelength  $0.3 \text{ \AA}$  is scattered through an angle  $40^\circ$  by a loosely bound electron, find the energy of scattered photon. 3

OR

- 2 (a) Explain how the observation of Davisson-Gerner's experiment justifies the wave nature of matter. 4
- (b) Show how the quantization of angular momentum follows the concept of matter waves. 3
- (c) A bullet of mass 50 grams and an electron both travel with a velocity of 1000 m/s. What wavelength can be associated with them ? 3

3. (a) What do you mean by phase velocity and group velocity ? Obtain the relation between group velocity and phase velocity. 3
- (b) Explain a thought experiment to arrive at Heisenberg's Uncertainty Principle. 4
- (c) Calculate the minimum uncertainty in the location of a body having mass of 5 grams moving with a speed of 2 m/s and the minimum uncertainty in the location of an electron moving with speed of  $6 \times 10^7$  m/s. Given that the uncertainty in momentum  $P$ , for both  $\Delta P = 10^{-3} P$ . 3

**OR**

4. (a) Show that the wave function for a particle confined to move in infinite one-dimensional potential well of length (L) is given by  $E_n = \frac{n^2 h^2}{8mL^2}$ , where symbols have their usual meaning. Is the electron trapped in a potential well, allowed to take zero energy ? Why ? 5
- (b) Explain in short, the phenomenon of tunnelling that occurs when a beam of particles are incident on a potential barrier of finite width. 3

- (c) An electron has a speed of 600 m/sec, with an accuracy of 0.005 %. Calculate the uncertainty with which we can locate the position of electron.

2

5. (a) Define the following :

(i) Co-ordination number

(ii) Void space.

2

- (b) Show that the FCC structure possesses maximum packing density among the three crystal structures SC, BCC and FCC.

$1\frac{1}{2} + 1\frac{1}{2} + 2$

- (c) The density of copper is 8980 kg/m<sup>3</sup> and unit cell dimension is 3.6 Å. Atomic wt. of copper is 63.54. Determine crystal structure and also calculate atomic radius.

OR

6. (a) Obtain an expression for interplanar spacing between two adjacent planes of Miller indices (hkl) in a cubic crystal.

4

- (b) What are Miller indices ? Draw crystal planes having Miller indices (0 2 0) and (2 1 0).

3

- (c) Gold with atomic radius  $1.44 \text{ \AA}$  and FCC structure is being used to determine the wavelength of X-ray. Calculate the wavelength of X-ray if the (1 2 1) plane diffracts the beam by  $35^\circ$ . Assume first order diffraction. 3

7. (a) Explain in brief the concept of Fermi level. Derive an expression for Fermi energy in intrinsic semiconductor. What is the effect of temperature on Fermi level in an intrinsic semi-conductor ? 4

- (b) Obtain an expression for the contact potential ( $V_0$ ) for P-N junction diode in equilibrium. 3

- (c) Calculate the conductivity of pure silicon at room temperature, if :

$$\text{carrier concentration} = 1.6 \times 10^{10}/\text{m}^3$$

$$\text{electron mobility} = 1500 \text{ cm}^2/\text{V. sec}$$

$$\text{hole mobility} = 500 \text{ cm}^2/\text{V. sec.} \quad 3$$

**OR**

8. (a) What is Hall effect ? Derive an expression for Hall voltage and Hall co-efficient for an extrinsic semiconductor. 5

- (b) Explain V-I characteristics of Zener Diode. 2

- (c) An n-type Ge sample 3 mm wide has electron density of  $10^{21}/\text{m}^3$ . It is arranged in Hall effect experiment having magnetic field 5000 gauss and current density  $500 \text{ A}/\text{m}^2$ . Find Hall voltage. 3