

7. (a) Show that for an intrinsic semiconductor, the Fermi level lies at the middle of the band gap. 3
- (b) Derive the expression for Hall voltage and Hall coefficient for extrinsic semiconductor. 4
- (c) A strip of n-type germanium semiconductor of width 1 mm and thickness 1 mm has a Hall coefficient $10^2 \text{ m}^3/\text{C}$. If the magnetic field used is 0.1 T and the current through the sample is 1 mA, determine the Hall voltage produced and also find carrier concentration of electron. 3

OR

8. (a) Draw the energy band diagram for a pn-junction diode in equilibrium and show that height of potential barrier is given by $V_0 = \frac{K_T}{e} \ln \left[\frac{N_D N_A}{n_i^2} \right]$ where symbols have their usual meaning. 4
- (b) Explain, why in a transistor (i) the base is thin and lightly doped (ii) the collector is large in size. 2
- (c) Calculate the conductivity of Germanium plate having area 1 cm^2 and thickness 0.03 mm when a potential difference of 2 volts is applied across the faces. Given : concentration of free electron in Ge is $2 \times 10^{19} /\text{m}^3$ and $\mu_e = 0.39 \text{ m}^2/\text{V.s}$ and $\mu_h = 0.19 \text{ m}^2/\text{V.s}$. Also calculate the current produced in it. 4

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 :
 Question No. 1 **OR** Question No. 2
 Question No. 3 **OR** Question No. 4
 Question No. 5 **OR** Question No. 6
 Question No. 7 **OR** Question No. 8
- (3) Assume suitable data wherever necessary.
- (4) Use of non-programmable electronic calculator is permitted.

List of Constants

Planck's constant 'h' = 6.63×10^{-34} J.S.
 Charge of electron 'e' = 1.602×10^{-19} C.
 Mass of electron 'm' = 9.11×10^{-31} kg
 Velocity of light 'C' = 3×10^8 m/s
 Boltzmann's constant 'K' = 8.6×10^{-5} eV/K.
 Avogadro's number $N_A = 6.023 \times 10^{26}$ atoms/K-mol

1. (a) In Compton effect, considering elastic collision between a photon and a free electron write down equations of energy and momentum conservation. 3
- (b) Prove that a free electron can not absorb a photon completely. 3
- (c) X-ray of wavelength 1 \AA are scattered from a carbon block in a direction 90° . Calculate the observed Compton shift. How much kinetic energy is imparted to the recoil electron ? 4

OR

2. (a) What is de Broglie hypothesis ? Show how the quantization of angular momentum follows from the concept of matter waves. 3
- (b) Describe an experiment, which supports the existence of matter waves. 4
- (c) A bullet of mass 45 gm and an electron both travel with a velocity of 1200 m/s. What wavelengths can be associated with them ? Why is the wave nature of bullet not revealed through diffraction effect ? 3
3. (a) What do you understand by a wave packet ? Obtain the relation between group velocity and phase velocity. 4
- (b) Arrive at Heisenberg uncertainty principle with the help of a thought experiment. 3
- (c) Compute the minimum uncertainty in the location of a body having mass of 2 gm moving with a speed of 1.5 m/s and the minimum uncertainty in the location of electron moving with speed of $0.6 \times 10^8 \text{ m/s}$. Given $\Delta P = 10^{-3} P$. 3

OR

4. (a) Explain physical significance of wave function ψ . 2
- (b) Using Schrodinger's time independent equation, obtain an expression for eigen function of particle in one dimensional potential well of infinite height. 5
- (c) An electron is confined to move in a one dimensional potential well of length 5 \AA . Find the quantized energy values for the three lowest energy states in eV. 3

5. (a) Define :

- (i) Space Lattice
- (ii) Co-ordination number
- (iii) Atomic packing fraction
- (iv) Unit Cell. 4
- (b) What are Miller Indices ? Draw the planes (210) and (010) for simple cubic structure. 3
- (c) Aluminum has FCC structure. Its density is 2700 kg/m^3 . Calculate unit cell dimension and atomic radius. Atomic weight of aluminum is 26.98. 3

OR

6. (a) Show that FCC structure possesses maximum packing density and minimum percentage of void space among BCC and FCC. 4
- (b) Derive Bragg's law of X-ray diffraction. 3
- (c) The Bragg angle corresponding to the first order reflection from the plane (111) in a crystal is 30° when X-rays of wavelength 1.75 \AA are used. Calculate inter planer spacing and lattice constant. 3