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 m^3/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 $V_0 = \frac{K_T}{e} \ell n \left[\frac{N_D N_A}{n_i^2} \right]$ 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 2×10^{19} $/m^3$ and μ_e = 0.39 $m^2/V.s$ and μ_h = 0.19 $m^2/V.s$. 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 = 6.023×10^{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 Å are scattered from a carbon block in a direction 90º. 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 0.6×10^{8} 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 Å. 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 30º when X-rays of wavelength 1.75 Å are used. Calculate inter planer spacing and lattice constant. 3