FE I sem- I (CBS)

A.P. I

29/5/13

P4–RT–Exam.–Feb.–13–3–137

Con. 6874–13. **(REVISED COURSE)** **GS–5193**

(2 Hours) **[Total Marks : 60**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **three** questions from remaining Question Nos. **2** to **6**.
(3) Assume **suitable** data wherever **required**.
(4) **Figures** to the **right** indicate marks.

1. Attempt any **five** (Each carry equal weightage) :– **15**
   (a) Draw unit cells showing position of the atoms for –
      (i) a monoatomic BCC Crystal
      (ii) a monoatomic SC Crystal
      (iii) CsCl Crystal.
   (b) Fermi level in K is 2.1 ev. What are the energies for which the probabilities of occupancy at 300 K are 0·99 and 0·01.
   (c) Draw the energy band diagram of an unbiased p-n junction and mark the barrier potential and depletion region.
   (d) Write the relation between polarization and dielectric susceptibility and the relation between dielectric susceptibility and dielectric constant.
   (e) Why soft magnetic material are used in core of transformers.
   (f) Calculate the change in intensity level when the intensity of sound increases 1000 times its original intensity.
   (g) Explain cavitation effect.

2. (a) Derive an expression for Fermi level for an intrinsic semiconductor. ~~(1+1+1+1)~~ 04

   Draw the energy level diagram only, to show the effect of
   (i) temperature (ii) impurity atom concentration in low range and (iii) impurity atom concentration in high range. (1+1+1+1)

   (b) An elemental crystal has a density of 8570 kg/m^3 packing fraction is 0·68. Determine the mass of one atom if the nearest neighbour distance is 2·86 Å. **7**

3. (a) Prove that in a ferromagnetic material, power loss per unit volume in a hysteresis cycle is equal to the area under hysteresis loop. **(4 + 4)**
   An iron ring of mean circumferential length 30 cm and cross sectional area 1 cm^2 is wound uniformly with 300 turns of a wire. When a current of 0·032 Amp flows in it, the flux produced in the ring is 2×10^{-6} wb. Find the flux density, magnetic field intensity and permeability of iron.

   (b) Derive Bragg's law. Explain why x rays and not γ-ray are used for crystal structure analysis. What data about the crystal structure can be obtained from the x-ray diffraction pattern of a crystal. **(4 + 2+1)**

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4. (a) Find out the critical radius ratio of an ionic crystal in ligancy 6 configuration. What is the maximum size of cation in ligancy 6 configuration when the radius of anion is 2·02 $\mathring{A}$. **5**

   (b) In an n type semiconductor the Fermi level lies 0·4 ev below the conduction band. If the concentration of donor atom is doubled, find the new position of the Fermi level w.r.t. the conduction band. **5**

   (c) Explain the origin of electronic, ionic and orientational polarization and temperature dependence of respective polarizability. **5**

5. (a) Find out the intercepts made by the planes. (1 0 1) and (4 1 4) in a cubic unit cell. Draw [$\bar{1}$ 2 1) and [1 2 4] in a cubic unit cell. **5**

   (b) A bar of n type Ge of size 0·010m × 0·001m × 0·001m is mounted in a Magnetic field of 2 x 10^{-1}T. The electron density in the bar is 7 × $10^{21}/m^3$. If one millivolt is applied across the long ends of the bar, determine the current through the bar and the voltage between Hall electrodes placed across the short dimensions of the bar. Assume $\mu_e = 0{\cdot}39\ m^2/vs$. **5**

   (c) Define reverberation time. Write Sabine's formula explaining every term. What are the factors which determine the average absorption co-efficient of a material. **5**

6. (a) Explain the differences between three different liquid crystal phases w.r.t. the order in the arrangement of molecules, with the help of diagram. Which property of the liquid crystal is used for display. **5**

   (b) How a p-n junction diode is used to generate a potential difference in a photovoltaic solar cell. **5**

   (c) What is piezoelectric effect. Explain the working of a piezoelectric oscillator used to produce ultrasonic wave. **5**
