FE (SEM I) (RW) (All Branches)
(CBSGS)
Applied physics - I

Dec 2014

(REVISED COURSE) QP Code : **11958**

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

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

1. Attempt any **five** of the following :— **15**
   (a) Identify the type of lattice and number of atoms per unit cell for CsCl and $BaTiO_3$ (above 120°C) crystal structure.
   (b) Fermi Energy for Silver is 5·5 eV. Find out the energy for which the probability of occupancy at 300 K is 0·9.
   (c) Explain the formation of depletion region in an unbiased p-n junction.
   (d) Write three distinct differences between ionic and orientational polarization.
   (e) Draw the variation of permeability against external magnetic field for a paramagnetic and ferromagnetic material (below Curie temperature).
   (f) Mention only one solution for each of the following acoustical problems in a hall (i) echo (ii) dead spot and (iii) inadequate loudness.
   (g) What is piezoelectric effect ? Why ferro-electrics are preferred than quartz for the production of ultrasonic waves ? **2+1**

2. (a) What is effective mass ? Why the effective mass of holes is more than the effective mass of electrons ? **2+2**
   Draw the diagrams only (fully labelled and self explanatory) to show the variation of Fermi energy with (i) temperature and (ii) impurity concentration at high level, for an n-type semiconductor. **2+2**
   (b) Define space lattice and basis. A metal crystallizes with a density of 2·7 gm/cc and has a packing fraction of 0·74. Determine the mass of one atom if the nearest neighbour distance is 2·86Å. **1+1+5**

3. (a) Explain the variation in magnetic induction with magnetic field for a ferromagnetic material, using the domain theory and with the help of a graph. A magnetic field of 1800 Amp/m produces a magentic flux of 3×10^{-4} Wb in an iron bar of cross-sectional area 0·2 cm^2. Calculate the susceptibility and the permeability. **3+5**
   (b) How the variation in glancing angle is achieved while determining the crystal structure using (i) rotating crystal method and (ii) powder method ? **3+4**
   Calculate Bragg angle if (200) planes of a BCC crystal with lattice parameter 2·814Å give second order reflection with X-rays of wavelength 0·71Å.

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4. (a) Calculate the critical radius ratio of an ionic crystal in ligancy 4 configuration. 5
   (b) Determine the concentration of conduction electron in a sample of Silicon if one in every million Silicon atom is replaced by a Phosphorous atom. Assume every Phosphorous atom to be singly ionized. Si has a molar mass of 0·028 kg/mole and density of 2300 kg/m^3. 5
   (c) If a gas contains $1{\cdot}2 \times 10^{27}$ atoms/m^3 and radius of atom is 0·53 Å, then calculate electronic polarizability and dielectric constant. Find the capacitance of a parallel plate capacitor having this gas inside, with plate area 1 cm^2 and plate separation 0·12 cm. 5

5. (a) Find Miller Indices of a plane whose intercepts are a, 4a and a, where a is the lattice constant. Draw (102), [201] and $(0\bar{4}0)$ in a cubic unit cell. 5
   (b) In a semiconductor with Hall coefficient 145 cc/C having width of 2 cm and thickness 0·2 cm with a magnetic field induction of 2T along the smaller dimension, a current of 150 mA is passing. Calculate the current density and Hall voltage. 5
   (c) Write Sabine's formula explaining each term. Explain how this formula can be used for the determination of absorption coefficeint of a given material. 1+4

6. (a) Write five distinct differences between Frenkel and Schottky defect. 5
   (b) Explain how a voltage diference is generated in a p-n junction when it is used in a photovoltaic solar cell. 5
   (c) Explain the principle, construction and working of a magnetostriction oscillator to produce ultrasonic waves. 1+1+3