Thapar Institute of Engineering and Technology, Patiala

ES- 203, Materials Science and Engineering
BE 2nd Year, Ist Semester
End Semester Examination, Dec 2006

Time: 3 hrs MM = 72

Note: Attempt all questions in sequence. Answers should be brief and to the point.

Q.1 a. What do you understand by 'exchange energy' in a magnetic material. How can it be used to decide ferromagnetic phenomena in a substance.
b. What are metallic glasses? Why do they show minimum hysteresis losses? Give reasons.
c. Differentiate between hexagonal ferrites and garnets. Give their respective compositions.
d. Why <111> is a hard direction of magnetization in a Fe (BCC) crystal. Explain it on the basis of ferromagnetic domain theory.

(4X3)

Q.2 a. On what factors does the drift velocity of electrons depends when a conducting material is subjected to an electric field. Discuss them.
b. Calculate the intrinsic electrical conductivity of GaAs at 27°C and 70°C. What fraction of the current is carried by the electrons in intrinsic GaAs at 27°C. E_g of GaAs= 1.43 ev.
c. What are the salient features of high temperature superconductors? Why Type-II superconductors are preferred as compared to Type-I superconductors. Give reasons.
d. Differentiate between phonon and photon. Do both the particles follow the same statistics? Explain. What is their significance in Engineering materials.

(4X3)

Q.3 a. Under what circumstances does polarizability differs from polarization? Draw a profile to show how does polarization of a material vary with frequency and temperature.
b. Draw a plot of logarithm of carrier concentration as a function of reciprocal of absolute temperature for n-type semiconductor. Discuss the characteristics of the curve giving significance of the each region, if any.
c. Draw $BaTiO_3$ crystal structure and identify the ion sites in it. Show (110) plane in this structure and also calculate planer density of this plane.
(Given data: Ba^{2+}= 1.43 A°, O^{2-}= 1.32 A° and Ti^{4+} = 0.60A°).

(3X4)

Q.4 a. For a Cu target, characteristic peaks in X-Rays are produced ~~below~~ above 30kV. Explain why?

b. By which technique does the following structures of a material can be identified..
(i) Crystal Structure
(ii) Substructure
(iii) Liquid Crystal Phase
Give justification in each case.

c. Give the full form of the following abbreviations.
(i) OFHC (ii) NMR (iii) TEM (iv) ACSR (v) AFM (vi) SEM
Write down at least one application of each of these systems/techniques.

(3, 3, 6)

Q. 5 a. Draw a phase diagram of binary system consisting of elementsA-B from the following data: (use of graph paper is a must)
(i) Melting point of A= 1000°C and B= 800°C
(ii) The system undergoes eutectic reaction at 600°C at 40% B composition.
(iii) The maximum solubility of A in B and B in A = 10% and 5% respectively at eutectic temperature which drops down to zero at room temperature.
Mark each line showing the phases existing in the phase diagram.

b. Find the degree of freedom using Gibb's Phase rule for eutectic compositions at eutectic temperature, just above eutectic temperature and just below eutectic temperature.

(8, 4)

Q. 6 a. A dislocation when interacts with precipitate particles can cut through and also can by- pass through it. Which is most preferred one in terms of energy and why? Give reason showing the interactions.

b. Show (0001) and $(11\bar{2}0)$ plane separately in a HCP unit cell. Also find the effective number of atoms on these planes.

c. Show $(1\bar{1}1)$ and $(1\bar{1}0)$ planes in BCC unit cell. Find the planar density of these planes if the lattice parameter in both the cases is 'a'.

(3X4)