B 2384

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Second Semester

Electronics and Communication Engineering

PH 135 — MATERIALS SCIENCE

(Common to Metallurgical Engineering./Bio-Medical Engineering)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. The spacing between two successive planes in a crystal is 2.820 Å. If the wavelength of X-ray is 0.842 Å, find the angle at which second order Bragg's reflection will occur.

2. Explain the terms unit cell and packing fraction.

3. For copper at 20°C, the electrical and thermal conductivities are 1.72×10^{-8} ohm^{-1}m^{-1} and 3.86 W m^{-1}K^{-1} respectively. Estimate the Lorentz number.

4. With suitable diagram distinguish between direct and indirect band gap.

5. What is an intrinsic semiconductor? Give two examples.

6. How the mobility of charge carriers in semiconductors are related with temperature?

7. What are ferrites? How they are superior to magnetic materials?

8. Explain dielectric breakdown in dielectrics.

9. What are excitons?

10. Differentiate between phosphorescence and fluorescence.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive Bragg's law for X-ray diffraction in crystal.

(ii) Give an account of powder method of crystal structure analysis. (4 + 12)

Or

(b) (i) What is a Bravais lattice and what are the different Bravais lattice in the cubic system?

(ii) What is meant by crystal imperfection and classify the same in the order of their geometry?

(iii) Bring out the difference between edge and screw dislocations. (5 + 5 + 6)

12. (a) On the basis of free electron theory obtain expressions for electrical and thermal conductivities. Hence obtain Widemann–Franz law. (7 + 7 + 2)

Or

(b) (i) What are superconductors?

(ii) Mention the important property changes that occur in materials when they change from normal to superconducting state.

(iii) What is Meissner effect?

(iv) What are Type I and Type II superconductors?

(v) Mention three applications of superconductors. (2 + 3 + 4 + 4 + 3)

13. (a) (i) What is Hall effect?

(ii) Show that for a n type semiconductor the Hall coefficient R_H is given by $R_H = -\frac{1}{ne}$.

(iii) Describe an experiment for the measurement of Hall voltage. (3 + 6 + 7)

Or

(b) (i) Distinguish between metals and insulators.

(ii) Assuming Fermi-Dirac distribution derive an expression for the number of electrons per unit volume in the conduction band of an intrinsic semiconductor.

(iii) Show how this number depends on temperature. (3 + 9 + 4)

14. (a) (i) Classify the magnetic materials on the basis of spin.

(ii) What are ferromagnetic domains?

(iii) How the existence of domains are explained?

(iv) Draw a B–H curve and identify retentivity and coercive field.

(v) What is the energy loss/cycle? (2 + 3 + 4 + 4 + 3)

Or

(b) (i) Explain the different types of polarisation mechanisms in dielectrics.

(ii) Distinguish between polar and non–polar substance.

(iii) Derive an expression for the mean dipole moment when a polar substance is subjected to an external electric field. (4 + 2 + 10)

15. (a) (i) What are color centres?

(ii) What are the different types of color centres?

(iii) What are the different methods employed to produce color centres.

(iv) Define index of refraction, damping constant, penetration depth, reflectivity and transmissivity. (2 + 2 + 4 + 8)

Or

(b) (i) What is photo conductivity?

(ii) Give the principle of thermogrpahy and mention its applications.

(iii) What are liquid crystals?

(iv) What are the different phosphors used in CRO screens?

(v) Explain the working of LED. (3 + 4 + 2 + 3 + 4)
