Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐

Q 2457

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Second Semester

Electronics and Communication Engineering

PH 135 — MATERIAL SCIENCE

(Common to Bio-Medical Engineering and Metallurgical Engineering)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Explain the difference between edge and screw dislocation.

2. What are Miller indices? How they are determined.

3. At what temperature one can expect a 10% probability that electrons in silver have an energy which is 1% above the Fermi energy. Fermi energy of silver is 5.5 eV.

4. A super conducting fin has a critical temperature of 3.7 k at zero magnetic field and a critical field of 0.0306 Tesla at 0 K. Find the critical field at 2 K.

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

6. Explain Hall effect.

7. On the basis of spins of electrons distinguish between Ferro, Ferri and antiferro magnetic materials.

8. Explain electronic and orientational polarization in dielectrics.

9. What are color centers?

10. What is photo conductivity?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain the terms co-ordination number and packing fraction. (2)

    (ii) Show that the atomic packing fraction for fcc and hcp metals are the same. (5 + 5)

    (iii) For a simple cubic lattice show that

    $$d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$$ (4)

    Or

    (b) (i) Name the seven types of crystal systems and give the relation of length of axes and the angles between the axes of a unit cell in each type.

    (ii) Show analytically that a five fold rotation axis does not exit in a crystal lattice.

    (iii) Distinguish between crystalline and non-crystalline materials.

    (7 + 6 + 3)

12. (a) (i) Define Fermi energy.

    (ii) Write down the expression for Fermi Dirac distribution function and explain how does it vary with temperature.

    (iii) Derive an expression for the Fermi energy of a system of free electrons. (2 + 4 + 10)

    Or

    (b) (i) Explain drift velocity and relaxation time of free electrons in metals.

    (ii) What are the various drawbacks of classical free electron theory of metals?

    (iii) Explain the assumptions made in quantum theory.

    (iv) Express electrical conductivity in terms of Fermi energy.

    (4 + 4 + 4 + 4)

13. (a) (i) What is an intrinsic semiconductor?

    (ii) Obtain an expression for the carrier concentration in an intrinsic semiconductor.

    (iii) Under what condition will the Fermi level be in the middle of the forbidden gap? (2 + 12 + 2)

    Or

(b) (i) Show that for a p type semiconductor the Hall coefficient R_H is given by $R_H = \dfrac{1}{ne}$. (8)

(ii) Describe an experimental set up to measure the Hall voltage. (8)

14. (a) (i) Explain Heisenberg's criteria for ferro magnetism.

(ii) Describe the experimental evidence to demonstrate the existence of ferro magnetic domains and explain with necessary theory.

(iii) What are ferrites and how they are superior to ferro magnetic materials? (4 + 8 + 4)

Or

(b) (i) What is meant by local field in a dielectric?

(ii) How is it calculated for a cubic structure?

(iii) Deduce Clausius-Mosotli equation and explain its uses in predicting the dielectric constant of the solids. (4 + 7 + 5)

15. (a) (i) What is photo conductivity?

(ii) How does it arise?

(iii) Mention a few applications of this phenomenon.

(iv) Explain how F and V centers are formed. (4 + 4 + 4 + 4)

Or

(b) (i) What is liquid crystal?

(ii) Discuss in detail the difference between LED and LCD display system.

(iii) What are optical constants?

(iv) Mention four applications of thermography. (2 + 8 + 2 + 4)

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