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**A 1523**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Third Semester

Electrical and Electronics Engineering

PH 231 — MATERIAL SCIENCE

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. How is effective mass of electron different from ordinary mass of electron?
2. Determine the probability of occupation of an energy level at 1200 K. The energy level is 0.5 eV above Fermi energy level.
3. What is the effect of doped impurities in semiconductors?
4. What are compound semiconductors? Give examples.
5. What is magnetic hysteresis?
6. Define dielectric loss.
7. What are traps?
8. Can photoconductivity take place when the incident energy is less than the band gap of the material? If not why?
9. Give any two applications of nonlinear materials.
10. What is biocompatibility of materials?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive an expression for electrical conductivity based on classical free electron theory and also discuss whether it explains all the experimentally observed facts. (10)
- (ii) Explain the origin of band gap using band theory of solids. (6)

Or

- (b) (i) Define density of states and obtain an expression for density of states. What is the use of density of states? (10)
- (ii) Describe the properties of superconducting materials. (6)
12. (a) (i) What are *n*-type and *p*-type semiconductors? Derive an expression for the carrier concentration of an *n*-type semiconductor. (10)
- (ii) Discuss the variation of carrier concentration with increase in temperature in semiconductors and also explain how it influences the electrical conductivity. (6)

Or

- (b) (i) What is Hall effect? Obtain an expression for Hall coefficient. Describe the experimental arrangement used for the determination of Hall coefficient. (10)
- (ii) A semiconductor crystal 10 mm long, 5 mm wide and 1 mm thick is subjected to a magnetic flux density of 0.5 T applied from front to back perpendicular to the largest face. When a current of 20 mA flows length wise through the specimen the voltage measured across its width is 37  $\mu$ V. Find the Hall coefficient of the semiconductor. If the conductivity of the semiconductor is  $3.1 \times 10^{-2} \Omega^{-1} \text{m}^{-1}$ , calculate the mobility of charge carriers. (6)
13. (a) (i) Explain dia, para, ferro, antiferro and ferri magnetic materials. List also their properties. (10)
- (ii) Discuss domain theory of ferromagnetism. (6)

Or

- (b) (i) What is local field? Derive an expression for local field and hence deduce Clausius-Mosotti relation. (10)
- (ii) What is dielectric breakdown? Explain intrinsic and thermal dielectric breakdown mechanisms. (6)

14. (a) (i) What are colour centres? Describe in detail the different types of colour centres using diagrams. Also discuss the importance of colour centres. (10)
- (ii) Give an account on the optical properties of semiconductors and insulators. (6)

Or

- (b) (i) Describe how liquid crystal is used as a display material and explain the working of a twisted nematic LCD display. (10)
- (ii) Give an account on photoconductivity and photoconductive materials. (6)
15. (a) (i) What are shape memory alloys? Explain the phase change behaviour of shape memory alloys and mention some of their applications. (10)
- (ii) What are metallic glasses? Explain their use as transformer core material. (6)

Or

- (b) (i) What are advanced ceramics? Discuss the characteristics and applications of advanced ceramics. (10)
- (ii) Explain the classification of polymers as thermoplasts and thermosets. Also discuss the structure of polymers. (6)