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Question Paper Code : 72385

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Second Semester

Civil Engineering

PH 6251 — ENGINEERING PHYSICS — II

(Common to all branches except Biotechnology and Pharmaceutical Technology)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Calculate the value of Lorentz number from Wiedemann-Franz law.

2. What is the mechanism of thermal conduction in metals?

3. Si and Ge have four valence electrons each. Why does their electrical conductivities are zero at $T = 0\,K$?

4. Current is due to flow of electrons. How does current flow in a p-type semiconductor which has holes as charge carriers?

5. Liquid oxygen in a test tube is suspended between the pole pieces of a magnet. How does it behave? What type of magnetic material is liquid oxygen?

6. The critical field for niobium at 0 K is 2×10^5 A/m and at 8 K, it is 1×10^5 A/m. Calculate the transition temperature of the element.

7. Define the terms dielectric susceptibility and polarizability.

8. In what way do ferroelectric materials differ from ordinary dielectric?

9. What are shape memory alloys?

10. How does the electrical properties of a material changes when they are reduced to nano dimension?

PART B — (5 × 16 = 80 marks)

11. (a) (i) What are the essential concepts of classical free theory of metals and quantum free electron theory of metals? Discuss the success and failures of both the theories. (6)

(ii) Derive an expression for electrical conductivity of metals based on the concepts of classical free electron theory. (6)

(iii) A copper wire 3.2 mm in diameter, carries a current of 0.5 A. Valency of copper is one. Atomic weight and density of copper are 63.5 and 8900 kg/m^3 respectively. Calculate the speed of conduction electrons. (4)

Or

(b) (i) What is meant by Fermi energy in metals? Based on quantum theory derive an expression for density of energy states, hence obtain an expression for Fermi energy. (12)

(ii) The Fermi energy for Al is 11.7 eV Find the probability that the state with energy 11.8 eV be occupied at 0 K and at room temperature (300 K.) (4)

12. (a) (i) Explain with necessary theory the Hall method of identification of p-type or n-type semiconductors and to determine the mobility of charge carriers. (12)

(ii) A rectangular sample of n-type germanium has a donor density of 10^{21}/m^3. It is arranged in a Hall experiment having a magnetic field of 0.4 T perpendicular to the plane of the sample. Find the Hall voltage when the current is 5 A and the sample is 3 mm thick. If the magnetic field is reduced to half the value what will be the Hall voltage. (4)

Or

(b) (i) Derive an expression for electrical conductivity of an intrinsic semiconductor. Describe the experiment to determine the band gap of the semiconductor. (12)

(ii) The forbidden energy gap of intrinsic silicon semiconductor is 1.1 eV. Compare the density of conduction electrons at 27°C and at 37°C. (4)

13. (a) (i) Define the terms orbital magnetic moment, spin magnetic moment and Bohr magneton. (6)

(ii) Explain the hysteresis property exhibited by ferromagnetic magnetic materials using domain theory. (10)

Or

(b) (i) Explain the important properties exhibited by superconductors. (12)

(ii) Explain the principle of magnetic levitation. (4)

14. (a) (i) Explain the mechanism of polarization in ionic crystals and polar materials. (12)

(ii) The atomic weight and density of sulphur are 32 and 2080 kgm^{-3} respectively. The electronic polarizability of sulphur atom is 3.28×10^{-40} F m^2. Solid sulphur has cubical symmetry. Calculate its dielectric constant. (4)

Or

(b) (i) Explain in detail the use of dielectric materials in capacitors and transformer cores. (12)

(ii) Explain dielectric loss and find an expression for dielectric power loss. (4)

15. (a) (i) Explain the optical phenomenon of birefringence. Give the technological applications of this phenomenon. (8)

(ii) Describe the chemical vapour deposition method of preparing nano materials. What are the limitations of this method? (8)

Or

(b) (i) What are metallic glasses? What are the characteristic properties exhibited by them. Give its usefulness as transformer core material. (12)

(ii) Give the applications of biomaterials in the field of ophthalmology. (4)