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Question Paper Code : 27472

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

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. Draw qualitatively Fermi-Dirac distribution function at $T = 0$ K and at a temperature $T > 0$ K.
2. Calculate the drift velocity of conduction electrons in a copper wire of cross-sectional area 5 mm^2 carrying a current of 5 A. Conduction electron density in copper is $8.5 \times 10^{28} / m^3$.
3. Calculate the electrical conductivity of silicon at room temperature doped with 5×10^{16} phosphorous atoms /cm^3. Assume that all the impurities are ionized at room temperature. (Mobility of electrons and holes in silicon are 1350 cm^3/Vs and 450 cm^3/ Vs respectively).
4. The Hall effect experiment is performed to determine the mobility of holes in a p-type silicon. The resistivity and thickness of the sample are 2.0×10^5 Ω cm and 2 mm respectively. For an applied magnetic field of 0.1 T and current of 5 μA, the measured Hall voltage is 30 mV. Find the mobility of holes.
5. What are magnetic domains? Are they present in all the materials?
6. What causes conduction electrons to pair together in conventional superconductor?
7. The relative permittivity of diamond and germanium are 5.8 and 16 respectively. Give reasons why relative permittivity of germanium is greater than diamond.
8. Why dielectrics are used in capacitors?
9. Why metallic glasses are used as transformer core materials?
10. What is Kerr effect?

PART B — (5 × 16 = 80 marks)

11. (a) Derive the expression for electrical and thermal conductivities of metals following the assumptions of classical free electron theory. Hence deduce Wiedemann-Franz law. (16)

Or

(b) (i) Derive an expression for density of energy states. (8)

(ii) Derive an expression for conduction electron density in metals. (8)

12. (a) Derive the expressions for intrinsic carrier concentration and electrical conductivity of an intrinsic semiconductor. Explain the variation of electrical conductivity with temperature and band gap of the semiconductor. (16)

Or

(b) Explain p- type semiconductor and derive an expression for the position of Fermi level. Explain the behaviour of this semiconductor at high temperature. (16)

13. (a) (i) Explain the classification of materials based on magnetic behaviour with examples. (12)

(ii) What type of magnetic materials are used in magnetic tapes and electromagnets for data storage? (4)

Or

(b) (i) Explain the terms critical temperature, critical magnetic field and critical current density and their significance for superconductors. (8)

(ii) Explain the interaction of type-I and type-II superconductors with external magnetic field. (8)

14. (a) (i) Explain the different mechanism by which a dielectric material loses its insulating property. (8)

(ii) Explain the behaviour of a dielectric material in an alternating electric field of different frequency range. (8)

Or

(b) (i) Define the term polarizability in dielectrics. Derive an expression for electronic polarizability. (8)

(ii) Explain ferroelectric materials. Give its applications. (8)

15. (a) (i) What are the properties exhibited by nanomaterials? Explain any one method of preparing nanomaterials. (8)

(ii) What are biomaterials? Give the applications of biomaterials in ophthalmology and dentistry. (8)

Or

(b) (i) What are shape memory alloys? Give their characteristic properties and applications. (8)

(ii) Explain different kinds of shape memory effect with schematic diagram. (8)

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