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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 30314

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Second Semester

Aerospace Engineering

PH 3251 — MATERIALS SCIENCE

(Common to : Automobile Engineering / Industrial Engineering / Industrial Engineering and Management / Manufacturing Engineering/ Marine Engineering / Mechanical Engineering / Mechanical Engineering (Sandwich)/ Production Engineering / Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Calculate the lattice constant for FCC crystal having atomic radius 1.476 Å.

2. Define "Phase".

3. Give any four postulates of classical free electron theory.

4. Calculate the intensity of magnetization of a material when a magnetic field of 2000 A/m is applied and has susceptibility of 1000.

5. The intrinsic carrier density at room temperature in Ge is $2.37 \times 10^{19} / m^3$. If the electron and hole mobilities are 0.38 and $0.18 m^2 V^{-1} s^{-1}$ respectively, calculate the resistivity.

6. Distinguish direct and indirect band gap semiconductors.

7. What is known as optical absorption in semiconductors?

8. What are Plasmonics?

9. What is known as Zener-Bloch oscillations?

10. Give some examples of optoelectronic devices.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain line imperfections in crystals with illustrations and calculate Burger's vectors. (8)

(ii) With neat diagram, explain HCP crystal structure and calculate the packing density. (8)

Or

(b) (i) Explain the transformation of liquid to crystals by nucleation and growth processes. (8)

(ii) Explain free energy changes in heterogeneous nucleation with diagram. (8)

12. (a) (i) Derive the expression for electrical conductivity and thermal conductivity of metals. (12)

(ii) Calculate the electrical conductivity of conducting rod at room temperature if collision time for electron is 2×10^{-14} sec. Given $n = 8.5\times10^{28}$ electrons/m^3. (4)

Or

(b) (i) Explain para and dia magnetism and its material properties. (12)

(ii) In a magnetic material, the field strength is found to be 10^6 A/m. If the magnetic susceptibility of the material is 0.5×10^{-5}, calculate the intensity of magnetization and flux density in the material. (4)

13. (a) (i) Derive an expression for electron concentration in n-type semiconductor and variation of Fermi level with temperature. (12)

(ii) The resistivity of intrinsic semiconductor Germanium at 300 K is 0.47 Ωm. If the electron and hole mobilities are 0.30 and $0.20\,m^2V^{-1}s^{-1}$ respectively, calculate the carrier density at 300 K. (4)

Or

(b) (i) What is Hall effect and derive the expression for Hall coefficient. (10)

(ii) Explain Schottky diode and obtain current density relation. (6)

14. (a) Explain carrier injection and various recombination processes in semiconductor with proper illustration. (16)

Or

(b) With neat diagram explain the construction and working of solar cell and light emitting diode devices. (16)

15. (a) Explain the Quantum structures such as Quantum well, wire and dot with suitable illustrations. (16)

Or

(b) Explain in detail the carbon nanotubes and its properties. Give its applications in various fields. (16)

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