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

Question Paper Code : 60052

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

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. What is crystal lattice?
2. Define Polymorphism.
3. Mention the failures of classical free electron theory.
4. State Fermi distribution law.
5. What do you mean by recombination of charge carriers?
6. In an N-type semiconductor, the concentration of electron is 2×10^{22} m^{-3}. Its electrical conductivity is 112 Ω^{-1} m^{-1}. Calculate the mobility of electrons.
7. Write any three optical properties of metals.
8. What is plasmonics?
9. Define quantum well.
10. What are passive optoelectronic device? Give an example.

PART B — (5 × 16 = 80 marks)

11. (a) Illustrate the various imperfections in crystals with neat sketch. (16)

Or

(b) Explain the arrangement of atoms in a Hexagonal unit cell. Determine coordination number, atomic radius and packing density of HCP system. (16)

12. (a) Derive an expression for electrical and thermal conductivities of metal. (16)

Or

(b) (i) Explain the properties of ferromagnetic materials with example. (6)

(ii) Arrive the formula for density of states in metals using quantum free electron theory. (10)

13. (a) Derive an expression for the total charge carrier concentration in an intrinsic semiconductor. (16)

Or

(b) Describe the theory of Hall effect and determine the Hall Co-efficient for p type semiconductor with neat diagram. (16)

14. (a) Explain in detail the optical absorption and emission of materials with examples. (16)

Or

(b) (i) Discuss the principle, construction and working of a solar cell with neat sketch. (8)

(ii) Explain the construction and working of Laser diode with energy level diagram. (8)

15. (a) Elaborate the principle, construction and working of single electron transistor with characteristics. (16)

Or

(b) Explain the types, properties and applications of carbon nanotubes in detail. (16)

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

Question Paper Code : 70180

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Second Semester

Mechanical Engineering

PH 3251 — MATERIALS SCIENCE

(Common to : Aerospace Engineering/Automobile Engineering/ Industrial Engineering/Industrial Engineering and Management/ Manufacturing Engineering/Marine 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. What is linear density? Calculate linear density in [110] direction of FCC unit cell.

2. What is known as polymorphism in crystal?

3. Calculate the electrical conductivity of copper, which has electron density $2 \times 10^{28}/Cm^3$ and $\tau = 10^{-4}$ second.

4. What is electron effective mass?

5. What is an indirect band gap semiconductor? Give example.

6. Distinguish drift current and diffusion current.

7. What is known as recombination in semiconductor?

8. Calculate the wavelength emission of GaAs semiconductor which has a band gap of 1.44 eV.

9. What is known as resonant tunneling?

10. What is spintronics?

PART B — (5 × 16 = 80 marks)

11. (a) (i) With neat diagram, explain BCC and FCC crystal structures. (8)

(ii) Explain grain and twin boundary imperfections in crystals. (8)

Or

(b) (i) What is known as nucleation? (2)

(ii) Explain homogeneous and heterogeneous nucleation processes in crystal growth. (14)

12. (a) (i) Derive the expression for density of energy states. (12)

(ii) The intrinsic carrier concentration of Ge at 300 K is 2.37×10^{19} m^{-3}. Calculate the electrical conductivity, if electron and hole mobilities are 0.38 $m^2 V^{-1}s^{-1}$ and 0.19 $m^2 V^{-1}s^{-1}$. (4)

Or

(b) (i) Explain domain theory of ferromagnetism and energies involved in domain growth. (12)

(ii) A paramagnetic material has a magnetic field intensity of 10^4 A/m. If the susceptibility of the material at room temperature is 3.7×10^{-3}, calculate the magnetization and flux density of the material. (4)

13. (a) (i) Derive an expression for electron and hole concentration in intrinsic semiconductor. (12)

(ii) If silicon has energy gap of 1.07 eV at 27°C, what is the probability of an electron being thermally promoted to conduction band? (4)

Or

(b) (i) Explain Hall effect phenomena and obtain an expression for Hall coefficient. (12)

(ii) A n-type semiconductor has Hall coefficient of 4.16×10^{-4} m^3 C^{-1}. The conductivity is 108 $ohm^{-1}m^{-1}$. Calculate its charge carrier density n_e and electron mobility (μ_e) at room temperature. (4)

14. (a) With neat diagram, explain optical absorption (coefficient) and various recombination processes in semiconductor. (16)

Or

(b) Explain the construction and working of solar cell and light emitting diode with illustrations. (16)

15. (a) Explain Quantum confinement and Quantum structures with figures. (16)

Or

(b) Explain in detail the principle of single electron transistor and its performance. (16)