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Question Paper Code : 60052

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 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)/Mechanical Engineering (Specialised in Automobile)/Mechanical Engineering (Specialised in Smart Manufacturing)/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 $2 \times 10^{22} \text{ m}^{-3}$. Its electrical conductivity is $112 \text{ ohm}^{-1} \text{ m}^{-1}$. 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.

Or

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

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

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.

Or

- (b) Describe the theory of Hall effect and determine the Hall Co-efficient for p type semiconductor with neat diagram.
14. (a) Explain in detail the optical absorption and emission of materials with examples.

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.

Or

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