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Question Paper Code : 21445

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

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. Define Unit Cell.
2. What is polymorphism?
3. Mention the failures of classical free electron theory.
4. Prove that $\chi_m = \mu_r - 1$.
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 $112 \text{ } \Omega^{-1} \text{ m}^{-1}$. Calculate the mobility of electrons.
7. Write any three optical properties of metals.
8. Suggest any two metals with high absorption co-efficient.
9. Define quantum confinement.
10. What is passive optoelectronic device?

PART B — (5 × 16 = 80 marks)

11. (a) Describe the various types of crystal imperfections in detail.

Or

- (b) Explain the arrangement of atoms in FCC and HCP unit cell with neat sketch.

12. (a) Derive an expression for electrical and thermal conductivities of metal. Using classical free electron theory.

Or

- (b) Arrive the formula for density of states in metals using quantum free electron theory.
13. (a) Derive an expression for carrier concentration in intrinsic semiconductor.
- Or
- (b) Explain the theory of Hall effect and determine the Hall Voltage and Hall Co-efficient for p type semiconductor.
14. (a) (i) Explain the working mechanism of P-N light detectors. (8)
(ii) Describe the principle and working of LED. (8)
- Or
- (b) (i) Elaborate the principle and working of a Solar cell. (8)
(ii) Explain the working of Laser diode with energy level diagram. (8)
15. (a) Explain the principle, construction and working of single electron transistor in detail.
- Or
- (b) Explain the types, properties and applications of carbon nanotubes in detail.
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