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Question Paper Code : 12035

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Second Semester

Mechanical Engineering

PH3251 — 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 Coordination number.
2. What is known as polymorphism in crystal?
3. Mention the failures of classical free electron theory.
4. Define density of energy states.
5. Differentiate between intrinsic and extrinsic semiconductors.
6. Distinguish drift current and diffusion current.
7. Write the principle behind the LED?
8. What is known as plasmonics.
9. Define quantum well.
10. What is known as Zener-Bloch oscillations?

PART B — (5 × 16 = 80 marks)

11. (a) Show that a hexagonal unit cell demands an axial ratio of $c/a = 1.633$. Determine the packing density of the HCP unit cell.

Or

- (b) (i) Discuss the grain and twin boundaries imperfections in crystals. (8)
(ii) Explain homogeneous and heterogeneous nucleation processes in crystal growth. (8)
12. (a) Deduce the mathematical expression for electrical conductivity and thermal conductivity of a metal.
- Or
- (b) (i) Derive an expression for effective mass of an electron. (8)
(ii) Explain dia and paramagnetism and discuss its material properties. (8)
13. (a) (i) Derive an expression for electron concentration in N-type semiconductors. (12)
(ii) Explain the difference between direct and indirect band gap semiconductors. (4)

Or

- (b) Define Hall effect. Derive expression for Hall coefficient and explain in detail how Hall coefficient can be determined experimentally.
14. (a) Explain in detail the optical absorption and emission of materials with examples.

Or

- (b) (i) Explain the working principle of LASER diode with a neat sketch. (8)
(ii) Using a suitable diagram explain the working of a solar cell. (8)
15. (a) (i) Explain the concept of the single electron transistor. (8)
(ii) Describe the construction and working of Resonant Tunneling Diode (RTD) with neat diagram. (8)

Or

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