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Question Paper Code : 51507

MECH - I

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Second Semester

Mechanical Engineering

PH 3251 – MATERIALS SCIENCE

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

(Also common to : PTPH 3251 – Materials Science for B.E. (Part-time) Second Semester – Mechanical Engineering – Regulations – 2023)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the terms linear and planar densities.
2. How do crystal imperfections affect the electrical properties of a metal and a semiconductor?
3. Define quantum tunneling.
4. What are GMR devices?
5. Draw the electronic band structure of a semiconductor.
6. What is the relation between mobility and diffusion coefficient?
7. List out four applications of optoelectronic devices.
8. Define the term Plasmonics.
9. What are the applications of single-electron transistors?
10. Mention the properties and application of spintronic devices.

PART B — (5 × 16 = 80 marks)

11. (a) Explain the concepts of Nucleation and growth. Describe the Homogeneous and Heterogeneous process of nucleation with necessary diagrams.

Or

- (b) Discuss in detail the edge and screw dislocations with neat diagram. Give a note on their effect on crystal stability.

12. (a) Derive expression for electrical conductivity and thermal conductivity on the basis of classical free electron theory.

Or

- (b) Explain the ferromagnetic domain theory in detail and discuss exchange interaction in ferromagnetic materials with suitable example.

13. (a) Explain the variation of carrier concentration in n-type and p-type semiconductor with temperature.

Or

- (b) What is Hall effect? Derive an expression for Hall Coefficient and Hall angle. Describe an experiment for the measurement of the hall co-efficient. Mention its applications.

14. (a) Briefly discuss the modulator and switching devices with neat sketch. Also give an explanation for optical process in quantum wells.

Or

- (b) Explain with suitable diagram how laser action is achieved in homo junction and hetero junction diode laser.

15. (a) Write note a Zener–Bloch oscillations, resonant tunnelling and quantum interference effect.

Or

- (b) Describe the density of states in quantum well, quantum wire and quantum dot structure.