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Question Paper Code : 51507

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

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 the terms linear and planar densities.
2. How does the 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 optoelectronics device.
8. Define the term Plasmonics.
9. What are the applications of single-electron transistor?
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.
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