Reg. No. : E N G G T R E E . C O M

Question Paper Code : 51507

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 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.
