QP Code:ME2T03-3 **(Pages:2)**

Reg No : ..... Name : .....

MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

(Govt. Aided Autonomous Institution)

Third Semester B.Tech Degree (SAY) Examination, February, 2026

Course Code: B24ME2T03

Course Name: METALLURGY AND MATERIALS SCIENCE

Max. Marks: 100 Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)

Answer all questions

1. Explain how the movement and interaction of dislocations are responsible for the plastic deformation of metallic materials.
2. Copper has a FCC crystal structure and an atomic radius of 0.128 nm. Its atomic weight is 63.546 g/mol. Calculate its theoretical density.
3. How does temperature affect the rate of diffusion in a solid?
4. What are the coordination numbers for octahedral and tetrahedral void sites?
5. Analyze the effect of alloying elements (like Ni, Cr, Mo) on the Iron-Carbon phase diagram and its influence on the hardenability of steel.
6. What is a eutectic reaction and a eutectoid reaction?
7. What is the key feature of spheroidal graphite cast iron, and how does it affect its properties?
8. What is the role of chromium in steel alloys.
9. Name one type of superalloy and its primary alloying element.
10. Define fracture and name its two main types based on material behavior.

PART - B: 70 Marks (5 Qns x 14 Marks)

Answer any One full question from each module.

Module 1

11. Explain the coordination number, atomic packing factor (APF), number of atoms per unit cell and relationship between atomic radius (r) and lattice parameter (a) for SC, BCC, and FCC structures.

OR

12. Sketch the following planes $(10\bar{1}), (2\bar{1}1), (3\bar{1}3), (3\bar{1}2)$ and directions $[301], [\bar{2}12], [\bar{1}1\bar{1}], [10\bar{2}]$. Show new origin and all necessary calculations.

Module 2

13. Differentiate between i). high-angle and low-angle grain boundaries, ii). tilt and twist boundaries . Explain the role of grain boundary characteristics.

OR

14. Explain in detail the mechanisms of dislocation motion, multiplication, and interaction. Illustrate with suitable diagrams.

Module 3

15. Describe how TTT curves are useful in the heat treatment processes of steel.

OR

16. Describe the Jominy end quench test and its procedure. Explain how the results are used to determine the hardenability of steel.

Module 4

17. Evaluate the roles of cold working and hot working in shaping and strengthening metal alloys. Elaborate on the mechanisms of recovery, recrystallization, and grain growth associated with plastic deformation.

OR

18. Explain any four types of steel, focusing on their composition, heat treatment, and applications.

Module 5

19. Define the Ductile-to-Brittle Transition Temperature (DBTT) and discuss its significance in material selection for low-temperature applications. Discuss the procedure and significance of impact tests in determining the DBTT.

OR

20. Describe the phenomenon of creep, its stages, and its implications for high-temperature applications.

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