Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: BE03000221 **Date: 17-12-2025**

Subject Name: Material Science and Metallurgy

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions

1. Attempt all questions.

2. Make suitable assumptions wherever necessary.

3. Figures to the right indicate full marks.

4. Simple and non-programmable scientific calculators are allowed.

			Marks
Q.1	**(a)**	Define (a) strength, (b) elasticity and (c) hardness.	**03**
	(b)	Classify engineering materials and explain their applications.	**04**
	(c)	Describe the key factors that influence the selection of materials for different engineering applications.	**07**
Q.2	**(a)**	Define Atomic Packing Factor (APF).	**03**
	(b)	Differentiate between Edge Dislocation and Screw Dislocation.	**04**
	(c)	Explain the Bravais lattice with their seven crystal systems and corresponding fourteen Bravais lattices.	**07**
		OR	
	(c)	Explain crystal imperfections and their effect on material properties.	**07**
Q.3	**(a)**	Discuss the formation of grains and dendrites structures during cooling in metals.	**03**
	(b)	State the Hume–Rothery rules and discuss their significance in the formation of solid solutions.	**04**
	(c)	With the help of a neat diagram, explain the Iron–Iron Carbide equilibrium diagram and its major phases.	**07**
		OR	
	(a)	What is Gibbs' phase rule?	**03**
	(b)	Explain non-equilibrium cooling with suitable diagram.	**04**
	(c)	Define allotropy and explain it with reference to iron.	**07**
Q.4	**(a)**	Explain eutectic and eutectoid reactions with suitable examples.	**03**
	(b)	Apply the Lever Rule to calculate phase percentages in a binary phase diagram.	**04**
	(c)	Explain the heat treatment processes: annealing, normalizing, and hardening.	**07**
		OR	
	(a)	Draw and explain TTT diagram for eutectoid steel.	**03**

	(b)	Describe the Jominy End Quench Test. How is it used to determine the hardenability of steel?	**04**
	(c)	Justify the use of surface hardening techniques like carburizing for gears and induction hardening for crankshafts.	**07**
Q.5	**(a)**	Define powder metallurgy. State its advantages.	**03**
	(b)	Explain Dye Penetrant Testing (DPT) with its principle, procedure, and applications.	**04**
	(c)	Discuss Magnetic particle test with advantages and limitations.	**07**

OR

	(a)	Define corrosion and classify its types.	**03**
	(b)	Explain cathodic protection and other corrosion prevention techniques.	**04**
	(c)	Compare Destructive Testing and Non-Destructive Testing methods with appropriate examples.	**07**

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