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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 23ME3ESMSM /22ME3ESMSM **Max Marks: 100**
Course: Materials Science and Metallurgy

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	*CO*	*PO*	Marks
1	a)	A material has undergone plastic deformation and on observation using a suitable instrument, there was a formation of mechanical twins and slip in the material. Explain the mechanism of slip and twinning.	*CO1*	*PO1*	**10**
	b)	Explain the concepts of Bauschinger's effect and Critically resolved shear stress.	*CO1*	*PO1*	**10**
		OR			
2	a)	With a neat sketch explain the behavior of a material subjected for a tensile/ compression load under prolonged thermal perturbation.	*CO1*	*PO1*	**10**
	b)	Materials subjected for completely reversal cyclic loading will fail prematurely. Stating its cause, with an experimental support ,comment on this property referring to both ductile and brittle materials.	*CO1*	*PO1*	**10**
		UNIT - II			
3	a)	Retaining homogeneity in metallic state is governed by rules. Stating them, comment on the types of solid solution.	*CO1*	*PO1*	**10**
	b)	The critical radius of nucleation is having a greater influence of Surface and Volume energy. Considering these two energies and their responses, show this radius mathematically is $-2\gamma / \Delta G$,	*CO1*	*PO1*	**10**

			OR			
	4	a)	Two metals A and B are used to form an alloy containing 75%A and 25% B. A melt at 650 °c and B at 450 °c. The solid solubility of metal A in B and of B in A are negligible. The metal pair forms a eutectic at 40%A and 60% B which solidifies at 300 ° c. Assume the liquidus and solidus line to be straight. Draw the phase diagram for the alloy series and find; i) The temperatures at which the alloy starts and completes solidification. ii) The percentage of eutectic in the alloy at room temperature. iii) The amount of liquid present and its composition, at a temperature of 390° c. iv) Specific gravity of the alloy, if specific gravity of metal A is 2.0 and metal B is 7.0.	*CO2*	*PO1*	**10**
		b)	Two solids will completely mix both in their liquid and solid states. Stating its type, extract the corresponding phase diagram and explain.	*CO2*	*PO1*	**10**
			UNIT - III			
	5	a)	Draw Fe-C equilibrium diagram with all phase fields with temperatures and corresponding microstructures. Explain equilibrium diagram and all the invariant reactions.	*CO2*	*PO1*	**16**
		b)	A foreign element can be added to tune up some basic properties for specific applications. Explain the different alloying elements added to steel.	*CO2*	*PO1*	**04**
			OR			
	6	a)	Throw some light on experimental procedure for constructing Temperature Time Transformation diagram for eutectoid steels.	*CO2*	*PO1*	**14**
		b)	TTT diagram is more useful when compared to equilibrium Fe-C system". Justify	*CO2*	*PO1*	**06**
			UNIT - IV			
	7	a)	Heat treatment in metallurgy is useful in many aspects. Along with its general objectives define it.	*CO3*	*PO1*	**08**
		b)	Flame hardening, Carburizing and Cyaniding are most promising heat treatment process. Along with the applications, describe the procedure.	*CO3*	*PO1*	**12**
			OR			
	8	a)	What is diffusion. What are the factors affecting diffusion, explain them in detail.	*CO3*	*PO1*	**10**

		b)	Explain the steady and unsteady state diffusion as discussed by Adolf Fick.	*CO3*	*PO1*	**10**
			UNIT - V			
	9	a)	Define composite material. Give the classification based on matrix, geometry of reinforcement and construction.	*CO3*	*PO1*	**08**
		b)	Explain stir casting method to produce Metal Matrix Composites with a neat sketch	*CO3*	*PO1*	**06**
		c)	With a neat sketch explain pultrusion process for FRP manufacturing	*CO3*	*PO1*	**06**
			OR			
	10	a)	FRP s can be manufactured by Spray-up process for high smooth surface like Boat hull. Support this statement with a sketch.	*CO1*	*PO1*	**07**
		b)	POLYMER COMPOSITES are used in production of tubular structures Support this statement with a sketch.	*CO1*	*PO1*	**07**
		c)	MMC s are very much supportive where lower weight and increased strength or durability are critical factors. Considering these aspects brief some applications.	*CO1*	*PO1*	**06**

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