Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, APRIL / MAY 2024

MANUFACTURING ENGINEERING
Fourth Semester
ML5351 Engineering Materials and Metallurgy
(Regulation 2019)

Time: 3hrs | Max.Marks: 100

CO 1	Construct the iron-iron carbide phase diagram and estimate the phases present in the microstructure
CO 2	Select a suitable heat treatment process for ferrous alloys based on the requirements
CO 3	Choose suitable ferrous and non-ferrous alloys for specific engineering applications
CO 4	Use different polymer, ceramics and composites for a specific engineering applications
CO 5	Describe testing procedures and failure mechanisms

BL – Bloom's Taxonomy Levels
(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analyzing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	Differentiate: Solid solution alloy phase and intermediate alloy phase	2	1	2
2	How does a phase transition occur within the solid state?	2	1	2
3	State the limitations of Iron carbide equilibrium diagram?	2	2	1
4	What is the rationale behind classifying steel according to its hardenability?	2	2	2
5	How can we categorize alloying elements based on their distribution within the constituents of steel?	2	3	2
6	Provide examples of two tool steels along with their compositions?	2	3	1
7	State the properties and application of PMMA?	2	4	1
8	Classify composite based on reinforcement type.	2	4	1
9	Why ductility increases in most metals as the temperature is raised?	2	5	2
10	Draw the S-N curve for steel and aluminum.	2	5	1

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11 (a)	Differentiate between eutectic, eutectoid, peritectic, and peritectoid reactions in phase diagrams. Illustrate each reaction with a schematic diagram and explain its practical implications in alloy processing.	13	1	3
	OR			
11 (b)	Draw iron-iron carbide equilibrium diagram and discuss the phases present at different compositions and temperatures and their implications for the microstructure and properties of steels.	13	1	3
12 (a) (i)	Discuss the purpose of normalizing, the steps involved, and the microstructural changes that occur during normalizing.	7	2	3
(ii)	Analyze the practical significance of isothermal transformation (I.T.) diagrams in predicting phase transformations during non-	6	2	4

	OR			
12 (b) (i)	Illustrate the importance of tempering in achieving the desired balance of hardness and toughness in steel components	7	2	3
(ii)	How does the Jominy End Quench Test assess the hardenability of steel alloys?	6	2	4
13 (a) (i)	Discuss the properties and applications of Aluminum Copper alloys.	6	3	3
(ii)	Analyze the microstructural evolution and mechanical property changes during the malleablizing process in cast iron.	7	3	4
	OR			
13 (b) (i)	Discuss the properties and application of different types of stainless steel.	6	3	3
(ii)	Analyze the phase diagrams and application of brass alloys.	7	3	4
14 (a)	Discuss the properties and application of the following non-metallic materials. i) SIC, ii) Al_2O_3, iii) ABS and iv) PEEK	13	4	3
	OR			
14 (b)	With one example each, explain the properties and application of Metal matrix and polymer matrix composites	13	4	3
15 (a) (i)	Discuss the plastic deformation mechanism by slip.	7	5	3
(ii)	Discuss brittle fracture and ductile fracture.	6	5	3
	OR			
15 (b) (i)	Explain the Rockwell hardness testing method in detail.	7	5	3
(ii)	Enumerate the stage of creep failure mechanism with a sketch.	6	5	3

PART- C (1 x 15 = 15 Marks)

Q. No	Questions	Marks	CO	BL
16.	Calcium (melting point1560° F) and magnesium (melting point 1200° F) form a compound $CaMg_2$, which contains 45 percent calcium and melts at 1320 °F. This compound forms a eutectic with pure magnesium at 960 °F and contains 16 percent calcium. The solubility of the compound in magnesium is about 2 percent at the eutectic temperature and decreases to almost zero at room temperature. Magnesium is not soluble in the compound. A second eutectic is formed between the compound and calcium at 830°F containing 78 percent calcium, and there is no solid solubility between the compound and pure calcium. (i) Draw the equilibrium diagram to scale on a piece of graph paper labeling all points, lines and areas (ii) Evaluate the slow cooling of an alloy containing 30 percent calcium. Sketch the microstructure at room temperature and give the relative amounts of the phases present. (iii) Draw the cooling curve. (iv) Write the specific equation of the reaction that takes place at each horizontal temperature.	7 4 2 2	1	5