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

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2024

MANUFACTURING ENGINEERING

Semester III

MF23304 &ENGINEERING MATERIALS AND METALLURGY

(Regulation 2023)

Time:3hrs Max.Marks: 100

CO1	Construct the iron-iron carbide phase diagram and estimate the phases present in the microstructure.
CO2	Select a suitable heat treatment process for ferrous alloys based on the requirements.
CO3	Choose suitable ferrous and non-ferrous alloys for specific engineering applications
CO4	Use different polymer, ceramics and composites for a specific engineering applications
CO5	Describe testing procedures and failure mechanisms

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A(10x2=20Marks)

(Answer all Questions)

Q.No.	Questions	Marks	CO	BL
1	Mention any two conditions for forming substitutional and interstitial solid solutions.	2	1	L1
2	What is binary phase diagram? Provide an example with diagram.	2	1	L2
3	How are bainite and martensite transformations represented in TTT and CCT diagrams, and why is the CCT diagram more applicable to practical heat treatment processes than the TTT diagram?	2	2	L3
4	Contrast between austempering and martempering.	2	2	L2
5	What is the role of the θ' phase in the precipitation strengthening of Al-Cu alloys?	2	3	L2
6	State the principle behind the shape memory effect in SMAs?	2	3	L1
7	What are the main alloying elements in duralumin, and why is it preferred in the aerospace industry over pure aluminum?	2	4	L3
8	Mention any two properties and applications of ceramic matrix composites.	2	4	L1
9	In Griffith's theory, how does the material's surface energy influence the critical stress at which brittle fracture occurs?	2	5	L3
10	How does the difference in the indentation depth between micro-hardness and nano hardness testing influence the interpretation of hardness values in heterogeneous materials?	2	5	L3

PART- B(5x 13=65Marks)

(Restrict to a maximum of 2 subdivisions)

Q.No.	Questions	Marks	CO	BL
11 (a)	Draw the iron-iron carbide equilibrium diagram. Discuss all the invariant reactions, transformations and phases at various temperature and compositions.	13	1	L3
	OR			
11 (b)	Classify the different types of cast iron with its microstructure, properties and applications.	13	1	L3

12 (a)	Analyze the test to evaluate hardenability of a steel of your choice. Explain in detail the test procedure and interpretation of results with diagram.	13	2	L3
	OR			
12 (b)	A manufacturing firm wants to increase the wear resistance of a tool steel component. Analyze various hardening processes and recommend a hardening process and justify your selection.	13	2	L3
13 (a)	Compile the effects of various alloying elements such as Mn, Cr, W, Ni, Mo, and Ti in different types of steel with their properties and applications.	13	3	L3
	OR			
13 (b)	Identify and explain the properties and applications of different types of copper and nickel alloys.	13	3	L3
14 (a)	Classify polymers and discuss in detail the different properties and applications of thermoplastics and thermosetting polymers.	13	4	L3
	OR			
14 (b)	Compile the properties and applications of various composites and engineering ceramics.	13	4	L3
15 (a) i)	Describe the mechanism of plastic deformation by slip and twinning with neat sketch.	7	5	L2
ii)	Explain how tension, compression, and shear tests are used to assess the suitability of a material for automotive structures.	6	5	L2
	OR			
15 (b) i)	Enumerate the testing procedure in rockwell hardness test.	7	5	L2
ii)	With neat schematic explain charpy and izod impact test.	6	5	L2

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.	α-phase titanium alloy used in a critical spacecraft application exhibits signs of premature failure, and the material scientist needs to demarcate whether fatigue failure or creep failure caused the fracture. The component was exposed to cyclic loading and elevated temperatures over time. i) Critically analyze how load, stress concentration, temperature and material properties influence the mode of failure. Propose a detailed approach to investigating the failure mechanisms, types and stages, integrating fatigue testing, creep testing, and fractographic examination. ii) Based on your evaluation, recommend a strategy for mitigating similar failures in future components, considering material, design, and operational factors.	15	5	L5