RollNo. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2025

MATERIALS SCIENCE AND ENGINEERING
Fourth Semester
MS23403 Mechanical Metallurgy
(Regulation2023)

Time:3hrs Max.Marks: 100

CO1	Identify the role of dislocations and the mechanisms of plastic deformation.
CO2	Explain the strengthening mechanisms of polycrystalline and composite materials.
CO3	Analyze the nature of fracture and its underlying mechanism.
CO4	Appraise the micro-mechanics, factors and life predictions of components under fatigue loading.
CO5	Assess the behavior of materials under high temperature, metallurgical factors and life prediction of high temperature materials

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	Why the dislocations are not revealed in optical or scanning electron microscopy?	2	1	2
2	Write the condition for a large dislocation to disassociate into two partials?	2	1	2
3	What is the strengthening mechanism found in Al-SiC metal matrix composites?	2	2	1
4	What will be the effect of cold working on dislocation density and ductility?	2	2	2
5	Distinguish trans-granular and inter-granular fractures.	2	3	1
6	What is DBTT? State the factors affecting this transition.	2	3	1
7	What is S-N curve? Mention its significance.	2	4	1
8	Write any 3 methods of improving the fatigue life.	2	4	2
9	Distinguish Creep and Stress-Rupture test.	2	5	1
10	State any two characteristics of materials used for high temperature applications.	2	5	1

PART- B(5x 13=65Marks)

Q.No.	Questions	Marks	CO	BL
11 (a)	A black smith performing cold working resulted in generation of lots of dislocation in a polycrystalline material. Explain how this dislocation interaction from one grain with another affects the plastic deformation	13	1	4
	OR			
11 (b)	A materials enthusiast is curious in learning the role of dislocation in metal forming operation, As a materials science engineer could	13	1	4

	you please elaborate on the stress fields associated with edge and screw dislocations.			
12 (a)	XZY Surface engineering Co.Ltd is required to improve the strength of a nonferrous material which is non heat treatable. Suggest a suitable strengthening technique and explain the underlying mechanism.	13	2	4
	OR			
12 (b)	Explain the mechanism involved in solid solution strengthening and how it impedes the dislocation movement and improves strength of the given material.	13	2	4
13 (a)	A material is subjected to uniaxial tension test. From the load-displacement data obtained, what are the different properties you can determine highlighting the test procedure. Explain, how would you find (i) Resilience, (ii) toughness and (iii) Proof stress, true stress and true strain.	13	3	4
	OR			
13 (b)	A material failed under tension without any deformation and the fractured surface revealed the bright and granular fracture. Explain the mechanism involved in this kind of fracture.	13	3	4
14 (a)	A NDT engineer identified a surface crack of length "a_0" in a shaft subject to cyclic load of alternate tension- compression. The design engineer wish to adopt fail safe design, who believe the critical crack length "a_c" to be safe. How would you compute the number of reversals required to grow the crack from a_0 to a_c in the shaft.	13	4	4
	OR			
14 (b)	(i) Discuss in detail, how would you compute the number of reversals required to failure, when the component is subjected to variable stress amplitude using Miner's rule (ii) Sketch and label the morphology of a component failed due to fatigue	9 4	4	4
15 (a)	Discuss in detail the different mechanisms that are operating under the constant load applied over a longer duration under elevated temperature.	13	5	4
	OR			
15 (b)	(i) Sketch and explain the different stages of creep curve. (ii) Explain how the Larsen miller parameter is used to determine creep life of a material.	7 6	5	4

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.	A materials engineer in a renowned turbine manufacturing firm is involved in selecting a material for high temperature application. He need to select a suitable strengthening technique while performing material. Explain the steps involved in such strengthening mechanism.	15	2	4