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

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

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

Materials Science and Engineering

Fourth Semester

ML 5403 Mechanical Behaviour of Materials

(Regulation 2019)

Time: 3hrs

Max.Marks: 100

CO 1	Identify the role of dislocations and the mechanisms of plastic deformation
CO 2	Explain the strengthening mechanisms of polycrystalline and composite materials.
CO 3	Analyze the nature of fracture and its underlying mechanism
CO 4	Appraise the micro-mechanics, factors and life predictions of components under fatigue Loading
CO 5	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 (10 x 2 = 20 Marks)

(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	What are the classifications of dislocation based on the angle between the burger vector and line vector? Mention their conservative movement.	2	1	2
2	Distinguish (i) Jog and Kink and (ii) Climb up and climb down of an edge dislocation.	2	1	2
3	What is the strengthening mechanism found in the addition of Cu in Ag?	2	2	1
4	Mention the effect of strain hardening on (i) Grains and (ii) Ductility.	2	2	2
5	State the probable reason for the failures identified in Titanic and Liberty ships.	2	3	2
6	Why the flaws in the materials are considered as stress raisers?	2	3	2
7	Give any 2 examples each for constant amplitude and variable amplitude fatigue loadings.	2	4	1
8	Define stress ratio. Mention its significance.	2	4	1
9	What are the key differences between stress rupture and Creep test?	2	5	2
10	What is homologous temperature? What is a plot of homologous temperature vs shear strain rate?	2	5	1

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11 (a)	What are the two prominent mechanisms of plastic deformation? Explain the slip mechanism of plastic deformation in metallic materials, highlighting the critically resolved shear stress required in a single crystal and slip systems for different crystal structures.	13	1	4

	OR			
11 (b)	Discuss the influence of dislocation- dislocation interaction on plastic deformation.	13	1	4
12 (a)	Does the abrupt changes in crystallographic direction from one grain to the other impedes the dislocation movement? How does the grain size influences the strength and toughness of metals and alloys.	13	2	4
	OR			
12 (b)	What are the three main steps in precipitation strengthening? Explain how aging helps in improving the strength in Aluminium alloys.	13	2	4
13 (a)	Why brittle fracture is regarded as unstable? Highlight the basic mechanism of brittle fracture and derive the Griffith criteria. What is the correction factor to be included in this criteria for metallic material?	13	3	4
	OR			
13 (b)	What do you understand by DBTT? Discuss the factors that influence DBTT. How would you determine the DBTT?	13	3	4
14 (a)	Describe any one of methods of determining the fatigue strength of a material. What is the significance of the S-N curve?	13	4	4
	OR			
14 (b) (i)	How would you determine the fatigue life time of component analytically whose mean stress is not equal to zero?	6	4	4
(ii)	Discuss how you will estimate life time of component through Palmgren-Miner linear damage summation rule for loading sequence of variable stress amplitude.	7	4	4
15 (a) (i)	What is Creep? Sketch the creep curve and explain the various stages of creep.	8	5	4
(ii)	Explain the characteristics of materials for high temperature application.	5		
	OR			
15 (b)	Explain the various mechanisms of the creep failure.	13	5	4

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL
16. (i)	Derive the Paris-Erdogan equation for determining the number of reversals required to grow the smallest detectable crack into critical one.	8	4	5
(ii)	A fatigue test was conducted in which the mean stress was 70 MPa and the stress amplitude was 210 MPa, (a) Compute the maximum and minimum stress levels. (b) Compute the stress ratio. (c) Compute the magnitude of the stress range.	7	4	5