III Year I Semester	L	T	P	C
Code: 20ME5317	3	0	0	3

CREEP, FATIGUE & FRACTURE MECHANICS

Course Objectives:

The Students will acquire the knowledge:

1. To interpret the elasticity in metals and polymers
2. To discuss the Griffth's Theory and stress intensity factor
3. To outline the concepts of Fatigue.
4. To discuss Motivation for selection, cost basis and service requirements
5. To illustrate the modern metallic materials

UNIT I ELASTICITY IN METALS AND POLYMERS

Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non-crystalline material

UNIT II STRESS INTENSITY FACTOR AND FRACTURE TOUGHNESS

Griffth's Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson – Miller parameter, Deformation and Fracture mechanism maps.

UNIT III FATIGUE

Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

UNIT IV MOTIVATION FOR SELECTION

Cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep. Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing, Case studies in Materials Selection with relevance to Aero, Auto, Marine, Machinery and Nuclear Applications.

UNIT V MODERN METALLIC MATERIALS

Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Intermetallics, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

Elastic Plastic Fracture Mechanics (EPFM): Crack-Tip-OpeningDisplacement(CTOD),the J - contour integral and its determination, relationships between J and CTOD, crack-growth resistance curves, J-controlled fracture.

TEXT BOOKS:

1. Mechanical Behavior of Materials / Thomas H.Courtney / McGraw Hill / 2nd Edition / 2000
2. Mechanical Metallurgy/George E. Dicter / McGraw Hill, 1998.
3. Selection and use of Engineering Materials 3e / Charles J.A / Butterworth Heiremann.

REFERENCE BOOKS:

1. Engineering Materials Technology / James A Jacob Thomas F Kilduff / Pearson
2. Material Science and Engineering / William D Callister / John Wiley and Sons

Course Outcomes:

Upon successful completion of this course, the students will be able to:

1. Illustrate the concepts of elasticity in metals and polymers
2. Explain the Griffth's Theory and stress intensity factor
3. Summarize the concepts of Fatigue.
4. Describe the theory of Motivation for selection, cost basis and service requirements
5. Outline the concepts of modern metallic materials.