FATIGUE AND FRACTURE MECHANICS

PROFESSIONAL ELECTIVE - I

VI Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5AE39	PCC	3	0	0	3	30	70	100

COURSE OBJECTIVES

The Main objective of this course is to

1. Provide the basic knowledge on the mechanics of elastic and Plastic deformation,
2. Creep, Fracture and fatigue failure, as applied to metals, composites,
3. Ceramics Provide a thorough introduction to the principles of fracture mechanics.
4. Provide practical examples of the application of fracture mechanics to design and Life prediction

UNIT-I FATIGUE OF STRUCTURES

Introduction to fatigue, Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. Curves.

UNIT-II PHYSICAL ASPECTS OF FATIGUE

Phase in fatigue life - Crack initiation - Crack growth - Final fracture - Dislocations - Fatigue fracture surfaces.

UNIT-III STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - Cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner's theory.

UNIT-IV OVERVIEW OF ENGINEERING FRACTURE MECHANICS

Strength of cracked bodies - Potential energy and surface energy - Griffith's theory - Irwin - Orwin extension of Griffith's theory to ductile materials - Stress analysis of cracked bodies - Effect of thickness on fracture toughness.

UNIT-V FATIGUE DESIGN AND TESTING

Safe life and fail-safe design philosophies, Importance of fracture mechanics in aerospace structure, Application to structures

Text Books:

1. *J. F. Knott* (1983), Fundamentals of Fracture Mechanics, Butter Worth & Co., Publishers Ltd., London.
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Reference Books:

1. Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill, New Delhi, India, 2009.

COURSE OUTCOMES:

1. Ability to use simple continuum mechanics and elasticity to determine the stresses, strains, and displacements in a loaded structure.
2. Understanding and mathematical modeling of the elements of plastic deformation, with respect to continuum and microscopic mechanisms.
3. Ability to use creep data to predict the life of structures at elevated temperatures and the understanding of mechanisms of creeep deformation and fracture.
4. Use of fracture mechanics to quantitatively estimate failure criteria for both elastically and plastically deforming structures, in the design of life prediction strategies, and for fracture control plans, with examples from automotive, aerospace, medical, and other industries.
5. Understanding of fatigue and how this affects structural lifetimes of components