FATIGUE & FRACTURE

I Semester: AE								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BAEC03	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes:45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**TotalClasses:45**		

I. COURSE OVERVIEW:

Fracture mechanics and fatigue are essential to understanding the structural performance of real-world materials. Fracture mechanics is the study of the complex stress field around the tip of a crack and can be used to determine if an existing crack will propagate or arrest. Fatigue analysis is the study of fracture behavior under repeated cyclic loading. High cycle and low cycles fatigue are used in designing machine members subjected to various fatigue load conditions. Crack growth under fatigue and realistic conditions are analyzed which is used in the industries.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The concept of Endurance limit and methods to increase the endurance limit used in design of machine elements.
II. The Low cycle and High cycle Fatigue used in design of machine members.
III. The behavior of materials under static load and fatigue loads.
IV. The Strength of a cracked bodies under fatigue and static load conditions.

III. COURSE OUTCOMES:

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

CO 1	**Apply** the concept of stress and number of cyclic loadings on a given specimen for deterring the endurance limit.	**Apply**
CO 2	**Analyze** the behavior of a specimen under High cycle and Low cycle fatigues for design against fatigue failure	**Analyze**
CO 3	**Apply** the mathematical principles to High cycle and Low cycle fatigues for determining the failure loads	**Analyze**
CO 4	**Analyze** the influence of crack growth under fatigue loads and surface roughness for designing the member to withstand the crack	**Analyze**
CO 5	**Analyze** the various methods involved in crack detections techniques for identifying the surface cracks.	**Analyze**
CO 6	**Illustrate** the various methods involved in fatigue testing for determining the Endurance limit.	**Apply**

IV. COURSE SYLLABUS:

MODULE-I: FATIGUE OF STRUCTURES (08)

S.N.curves,Endurancelimit,Effectofmeanstress,Goodman,GerberandSoderbergrelationsanddiagrams,Notches and stress concentrations, Neuber‟s stress concentration factors, plastic stress concentration factors, Notched S-N curves.

MODULE-II: STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR (10)

Low cycle and high cycle fatigue, Coffin-Manson ‟‟relation, Transition life, Cyclic Strain hardening and softening Analysis of load histories, Cycle counting techniques, Cumulative damage, Miner‟s theory, other theories.

MODULE-III: PHYSICAL ASPECTS OF FATIGUE (10)
Phase in fatigue life, Crack initiation, Crack growth, Final fracture

Dislocations, Fatigue fracture surfaces.

MODULE-IV: FRACTURE MECHANICS (09)
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, stress intensity factors for typical geometries.

MODULE-V: FATIGUE DESIGN AND TESTING (08)
Safe life and fail safe design philosophies, importance of fracture mechanics in aerospace structure, application to composite materials and structures.

V. TEXT BOOKS:

1. D.Brock, “Elementary Engineering Fracture Mechanics”, Noordhoff International Publishing Co.,London, 1994.
2. J. F. Knott, “Fundamentals of Fracture Mechanics”, Butterworth & Co., (Publishers) Ltd., London, 1983.

VI. REFERENCE BOOKS:

1. W.BarroisandL.Ripley, “Fatigue of Aircraft Structures”, SPergamon Press, Oxford, 1983.
2. C. G. Sih, “Mechanics of Fracture”, Vol.1 Sijthoff and Noordhoff International Publishing Co.,Netherland, 1989.

VII. WEB REFERENCES:

1. http://ocw.mit.edu/courses/materials-science-and-engineering/3-35-fracture-and-fatigue-fall-2003.
2. http://www.eng.ox.ac.uk/solidmech/research/fatigue-fracture-mechanics.
3. http://www.fatiguefracture.com