SEMESTER 6

FATIGUE AND FRACTURE MECHANICS

Course Code	PEAOT633	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Mechanics of Materials	Course Type	Theory

Course objectives:

1. Understand about the fundamental source of failure of mechanical components.
2. Understand the fatigue design curve approaches and limitations.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**FATIGUE OF STRUCTURES:** S.N. curves - 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 – Fatigue of composite materials.	9
2	**PHYSICAL AND STATISTICAL ASPECTS OF FATIGUE:** Phases in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces. 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 -. Life Estimation	9
3	**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 - stress intensity factors for typical Geometries. Importance of Fracture Mechanics in aerospace structures Application to composite materials and structures.	10
4	**FATIGUE DESIGN AND TESTING**: Safe life and Fail-safe design philosophies, Crack Arrest / Repair Methodologies, Fracture Toughness Testing, Failure Assessment Diagram	8

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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

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Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the causes for the fatigue failure of the materials.	K2
CO2	Apply the causes of the crack initiation & its growth.	K3
CO3	Apply the mathematical knowledge to define fatigue behaviours of the materials	K3
CO4	Understand the fracture due to fatigue	K2

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	-

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Elements of Fracture Mechanics	Prasanth Kumar	Wheeter publication	1999
2	Fracture Mechanics – Fundamentals & Applications	Barrois W, Ripely, E. L	CRC press	Third edition, 2005

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced Fracture Mechanics	M.F.Kanninen and C.H.Popelar	Oxford press	1985
2	Elementary Engineering Fracture Mechanics	D.Broek	Martinus Nijhoff publishers	1982

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_mm42
2	https://onlinecourses.nptel.ac.in/noc22_mm42
3	https://onlinecourses.nptel.ac.in/noc22_mm42
4	https://onlinecourses.nptel.ac.in/noc22_mm42

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