FRACTURE MECHANICS OF CONCRETE STRUCTURES

(Professional Elective- III)

Course Code: 19CE2258	**L**	**P**	**C**
	3	**0**	**3**

Course Outcomes:
The students will be able to:
CO 1. Describe the fracture types and micro mechanism
CO 2. Describe the energy concepts in crack and crack resistance.
CO 3. Understand the linear elastic fracture mechanics.
CO 4. Describe elastic plastic fracture mechanics.
CO 5. Describe the crack propagation concepts

UNIT I: **(10-Lectures)**

INTRODUCTION

Review of a) Ductile and brittle fractures b) Conventional design practices, Need for fracture mechanics in design, Micromechanics of various types of fracture, Mode I, II and III cracks, Crack detection methods.

LO1: List the concepts in fracture mechanics
LO2: Underline micromechanics and various models in crack

UNIT II: **(10-Lectures)**

ENERGY RELEASE RATE AND RESISTANCE OF CRACK

Stress concentration concepts, Griffith's theory and Irwin's modification, Energy release rate, Change in compliance and strain energy approaches, Crack resistance curves, Plane stress and plane strain cases, Crack stability and instability conditions.

LO1: Explain concepts in stress concentration.
LO2: Explain concepts in the crack resistance curves.
LO3: Explain concepts of crack stability and instability conditions

UNIT III: **(10-Lectures)**

LINEAR ELASTIC FRACTURE MECHANICS

Linear Elastic Fracture Mechanics (LEFM), Conditions for validity of LEFM, Stress field around crack tip in Mode I, II and III cracks, Stress intensity parameter, Formulations under complex loads, Relation between stress intensity parameter and energy release rate, Crack tip plastic zone, Analysis of plastic zone size by conventional yield theories, Irwin's correction.

LO1: Examine concepts in linear elastic fracture mechanics
LO2: Analyze stress intensity parameters in crack growth

UNIT IV: **(10-Lectures)**

ELASTIC PLASTIC FRACTURE MECHANICS

Relevant and scope of elastic plastic fracture mechanics, J-Integral, Path independence, Stress-Strain relation
LO1: Categorize the relevance and scope of elastic plastic fracture mechanics
LO2: State the concepts in dealing with elastic plastic fracture mechanics

UNIT V: **(10-Lectures)**

CRACK TIP OPENING DISPLACEMENT AND FATIGUE

Introduction, Relationship between CTOD, KI, GI for small scale yielding, Equivalence between CTOD and J; S-N curve, crack initiation, crack propagation, effect of overload, variable amplitude fatigue load
LO1: State the concepts in crack tip opening.
LO2: Recognize concepts in crack initiation and propagation under fatigue Loading.

Textbooks:

1. T.L. Anderson, ‑Fracture mechanics: Fundamentals and Applications‖, 4th Edition. CRC Press, Taylors & Francis, 2017.

2. Broek David, ‑Elementary Engineering Fracture Mechanics‖, Springer Science & Business Media, 2012.

3. Campbell Flake C, –Fatigue and Fracture: Understanding the Basic‖, ASM International, Materials Park, Ohio, 2012.

References

1. Steven R. Lampman, ASM Handbook, Vol. 19, Fatigue and Fracture, etc., ASM International, 2002.

2. Chin-I Sun, Z.H. Jin, Fracture Mechanics, Academic Press, Elsevier, 1st Edition, 2012.

3. K. Ramesh, E-Book: Engineering Fracture Mechanics (With Trouble shooting and searching, multimedia facilities) by, IIT, Madras.