

COURSECONTENT

FRACTURE MECHANICS (PROFESSIONAL ELECTIVE – V)								
III semester :SE								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P		C	CIA	SEE
2532054	Core	3	0	0	3	40	60	100
Contact Classes:45	Tutorial Classes :Nil	Practical Classes:Nil			TotalClasses:45			
Prerequisites:NIL.								

Course Overview:

This course introduces fracture mechanics concepts applied to materials like concrete and steel. It covers failure theories, stress intensity factor, fracture toughness, and energy-based approaches such as energy release rate, R-curve, and J-integral. The limitations of linear elastic fracture mechanics and the need for nonlinear methods are discussed, including fracture energy and size effects. It also addresses shrinkage, creep, and shear transfer. The course concludes with failure modes, experimental testing methods, and practical case studies for structural fracture analysis.

Course Objectives:

1. To understand failure theories, fracture concepts, stress intensity factor, and fracture toughness.
2. To learn energy-based fracture parameters such as energy release rate, critical energy release rate, CMOD, R-curve, and J-integral.
3. To understand fracture mechanics applied to concrete and steel, including limitations of LEFM and nonlinear fracture methods.
4. To study fracture energy, size effect, shrinkage, creep, shear transfer, and failure modes in materials.
5. To learn test methods for fracture analysis supported by case studies and discussions.

Course Outcomes:

After completion of the course, students should be able to

1. Explain the concepts of failure theories, fracture, stress intensity factor, and fracture toughness.
2. Interpret the principles of energy release rate, critical energy release rate, crack mouth opening displacement, R-curve, and J-integral.
3. Analyze the need for fracture mechanics approach in concrete and the limitations of linear elastic fracture mechanics for concrete and steel.
4. Evaluate non-linear fracture methods with respect to fracture energy, size effect, shrinkage, creep, and shear transfer mechanisms.
5. Apply fracture analysis concepts to identify failure modes using test methods and case studies.



MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(AN AUTONOMOUS INSTITUTION)

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SYLLABUS:

UNIT-I:

Failure theories, Fracture, Definition of stress intensity factor, Fracture toughness

UNIT-II:

Energy release rate, Critical Energy release rate - Crack mouth opening displacement, R- Curve and J integral

UNIT-III:

Basic reasons for fracture mechanics approach for concrete, Limitations of linear elastic fracture mechanics for concrete and steel.

UNIT-IV:

Non- linear fracture method - Fracture energy and size effect. Shrinkage and creep, shear transfer.

UNIT-V:

Failure modes, Test Methods for fracture analysis, Case studies and discussions.

REFERENCES:

1. David Broek, Elementary Engineering Fracture Mechanics, Sijthoff and Noordhaff, Alphen Aan Den Rijn, The Netherlands, 2001.
2. Analysis of Concrete Structure by Fracture Mechanics, Ed L. Elfgren and S.P. Shah, Proc of Rilem Workshop, Chapman and Hall, London, 2001.
3. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009.
4. K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007.
5. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, Wiley, India, 5th Edition, 2014

ELECTRONICRESOURCES:

<https://nptel.ac.in/courses/112106065>

MATERIALSONLINE:

1. Course template
2. Tutorial question bank
3. Definitions and terminology
4. Assignments
5. Model question paper – I
6. Model question paper – II
7. Lecture notes
8. E-Learning Readiness Videos (ELRV)