FRACTURE MECHANICS OF CONCRETE STRUCTURES

III Semester: ST								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BSTC28	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

Over the last twenty years, many theoretical, numerical and experimental methods have evolved in the field of Fracture Mechanics of Concrete. These have led to practical applications in reinforced-concrete design, assessment, monitoring and retrofitting, as well as innovative high-performance and durable cementations materials. Although Fracture Mechanics of Concrete is now mature as a framework for defining and solving a variety of engineering problems, there is still much work to be done in improving previous theoretical and numerical models, and for re-interpreting established phenomena. In particular, there are new developments in the treatment of scale effects; the implementation of 3D-discretisation; and the combination of continuous and discontinuous models. Other areas of rapid progress are the development of innovative testing techniques; the proposal of non-local and anisotropic constitutive laws; the formulation of lattice and multistage models, and the development of coupled multifold theories.

II. COURSE OBJECTIVES:

The student will try to learn:

I. The concepts and principles of fracture mechanics for the analysis of structural components.
II. The analytical and computational tools needed to solve the idealized problems.
III. The fracture and fatigue behavior of different materials to focus on research in this area.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:		
CO 1	Describe the fracture types and micro mechanism for concrete structures	Analyze
CO 2	Explain the energy concepts in crack and crack resistance for the analysis of structural components.	Evaluate
CO 3	Demonstrate the linear elastic fracture mechanics for the propagation of cracks.	Analyze
CO 4	Interpret the importance of Crack tip plastic zone for durable concrete structures.	Analyze
CO 5	Explain micromechanics and various models in crack for fracture mechanics models.	Analyze
CO 6	Describe the crack propagation concepts for the applications of concrete structures.	Evaluate

IV.COURSE SYLLABUS:

MODULE-I: INTRODUCTION (09)

Fracture mechanics, crack in a structure, mechanisms of fracture and crack growth, cleavage fracture

MODULE-II: CRACKING MECHANISM (09)
Ductile fracture, fatigue cracking, environment assisted cracking, service failure analysis

MODULE-III: STRESS AT CRACK TIP (09)
Stress at crack tip, linear elastic fracture mechanics, Griffith's criteria, stress intensity factors.

Crack tip plastic zone, Erwin's plastic zone correction, R curves, compliance, J integral, concept of CTOD and CMD.

MODULE-IV: MATERIAL MODELS (09)
General concepts, crack models, band models, models based on continuum damage mechanics

MODULE-V: APPLICATIONS TO CONCRETE STRUCTURES (09)
Applications to High Strength Concrete, Fibre Reinforced Concrete, Crack Concepts and Numerical Modeling

V.TEXT BOOKS:

1. Suri C. T. and Jin Z.H., "Fracture Mechanics", Elsevier Academic Press, 1st Edition, 2012.
2. BroekDavid, "Elementary Engineering Fracture Mechanics", Springer, 3rd Rev, 1982.
3. Elfgreen L, "Fracture Mechanics of Concrete Structures – Theory and Applications", RILEM Report, Chapman and Hall, 1989.

VI. REFERENCE BOOKS:

1. Victor, Li C., Bazant Z. P, "Fracture Mechanics – Applications to Concrete", ACI SP 118, ACI Detroit, 1989.

VII. WEB REFERENCES:

1. http://www.nptel.ac.in/courses/112106065/#

VIII. E-TEXT BOOKS:

1. http://www.civil.northwestern.edu/people/bazant/PDFs/Papers/P90.pdf