BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus

Instruction Division
First Semester 2013-2014.
Course Handout (Part II)

Date: 27/07/2015.

In addition to part I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the courses.

Course No : DE G514
Course Title : FRACTURE MECHANICS
Instructor-in-charge : **Murali Palla**

Course Description: Types of failure, Types of fracture, Modes of fracture, Fracture criteria, Energy release rate, Stress intensity factor (SIF), SIF of more complex cases, An elastic deformation at the crack tip, Elastic plastic analysis through J-integral, Crack tip opening displacement, Test methods, Fatigue failure, Numerical analysis, Mixed mode crack initiation and growth.

Scope and objective of the course: The conventional design is based on yield point. However, it has been found that often a structural component fails even when the worst loaded point is well within the yield stress. Thus the design, based entirely on avoiding yielding is not adequate for certain cases. Fracture mechanics is based on implicit assumption that there exists a crack in the structural component. The crack may be inside the material or at the subsurface.

Text Book: Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2009.

Lect. No.	Learning Objectives	Topics to be covered	Ref. Chap./Sec.
1	Background	Kinds of failure and history	**1.1-1.7**
2 to 4	Energy release rate	Dilemma of Griffith, Surface energy, Griffith's realization Griffith's analysis, Mathematical formulation, Thin plate vs thick plate Critical energy release rate.	**2.1 to 2.13**
5 to 8	Stress intensity factor (SIF)	Linear elastic fracture mechanics (LEFM) Stress and displacement fields in isotropic elastic materials, Elementary properties of complex variables	3.1 – 3.6

9 to 12	SIF of more complex cases	Application of the principle of superposition, Crack in a plate of finite dimensions, Edge cracks, Embedded cracks, Relation between G_I and K_I	4.1 - 4.9
13 – 16	Anelastic deformation at the crack Tip	Further Investigation at the crack tip, Approximate shape and size of the plastic zone, Effective crack length, Effect of plate thickness.	5.1 – 5.5
17 to 20	Elastic plastic analysis through J-Integral	Relevance and scope, Definition of J-Integral, Path independence Stress-strain relation, Further discussion on J-Integral, Engineering approach-A short cut.	6.1 – 6.7
21 to 24	Crack tip opening displacement (CTOD)	Relationship between CTOD, K_I and G_I for small scale yielding Equivalence between CTOD and J.	7.1 – 7.4
25 to 28	Test methods	K_{IC} test techniques, Test methods to determine $J_{IC,}$ Test methods to determine G_{IC} and G_{IIC}, Determination of critical CTOD.	8.1 – 8.6
29 to 32	Fatigue failure	Terminology, S-N curve, Crack initiation, Crack propagation Effect of an overload, Crack closure, Variable amplitude fatigue load.	9.1 – 9.9
33 to 35	Numerical Analysis	Finite element method	10.1 – 10.3
36 – 38	Mixed mode crack initiation and growth	Fracture surface, Mixed mode crack propagation criteria, Crack growth.	11.1 – 11.5
39 - 42	Crack detection through NDT	Visual, LPI, Magnetic Methods, Radiography, Ultrasonics	12.1 – 12.7

Evaluation Scheme:

EC No.	Evaluation component	Duration	Weightage	Date, Time Venue	Nature of component
1	**Midsem Exam**	**90 minutes**	**30%**	17/3 11:00 - 12:30 PM	**OB**
2	**Projects/assignments**		**20%**		**OB**
3	**Compre.**	**3 Hrs.**	**50%**	10/5 AN	**CB**

Chamber Consultation Hours: To be announced in the class.
Notices: Mechanical Engineering Group notice board.

Instructor-in-charge

(DE G514)