BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-2021
COURSE HANDOUT

Date: 11.03.2021

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

Course No : **DE G514**
Course Title : **Fracture Mechanics**
Instructor-in-Charge : **Dr. Sharad Shrivastava**
Instructor(s) : **Dr. Sharad Shrivastava**
Tutorial/Practical Instructors:

1. Course Description: Types of failure, Types of fracture, Modes of fracture, Fracture criteria, Energy release rate, Stress intensity factor (SIF), Linear elastic fracture mechanics, environmentally assisted cracking (EAC), Weibill fracture statistics, Plane stress and plane strain, Elastic plastic analysis through J-integral, Crack tip opening displacement, R-curve, Test methods, Fatigue failure, Mixed mode crack initiation and growth, Crack detection through NDT.

2. 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.

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

4. Reference Books:

1. T. L. Anderson**,** Fracture Mechanics: Fundamentals and Applications, 3rd Edition, CRC Press.

2. E. E. Gdouto, Fracture Mechanics: An Introduction, 2nd Edition, Springer.

3. D. Broek, Elementary Engineering Fracture Mechanics, 4th Edition, Springer.

5. Course Plan:

Module No.	Lecture Session	Reference	Learning outcomes
1-2	Background	Textbook/Reference books/ Lecture notes	Kinds of failure and history
3-5	Energy release rate	Textbook/Reference books/ Lecture notes	Dilemma of Griffith, Surface energy, Griffith's realization Griffith's analysis, Mathematical

			formulation, Critical energy release rate.
6-8	Linear elastic fracture mechanics (LEFM)		Application of the principle of superposition, Crack in a plate of finite dimensions, Edge cracks, Embedded cracks, Case studies
9-14	Stress intensity factor (SIF).		Critical stress intensity factor, Fracture toughness and design, Fracture morphology and Failure Analysis. Stress corrosion cracking (SCC), Stages of SCC, v-K diagram, Weibull analysis, Weakest link model
15-17	Environmentally Assisted Cracking (EAC)		Further investigation of effects on environment on crack growth, Small crack effect, Cracking morphology, Variable influencing EAC, Hydrogen embrittlement
18-20	Plane stress and Plane strain		Definition of plane stress and plane strain, Conditions and requirements, Relation between G and Kin plane stress and plane strain conditions
21-24	Elastic plastic analysis		Relevance and scope, Path independence, Further discussion on J-Integral, Crack tip opening displacement (CTOD), Relationship between CTOD, K_I and G_I for small scale yielding, Equivalence between CTOD and J-

			Integral
25-27	Fatigue failure		Terminology, S-N curve, Crack initiation, Crack propagation Effect of an overload, Crack closure,
28-30	Mixed mode crack initiation and growth		Fracture surface, Mixed mode crack propagation criteria, Crack growth.
31-32	Crack detection through NDT		Radiography, Ultrasonics, acoustic emission, acousto-ultrasonics

6. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid-Semester Test	90 Min.	30		CB
Comprehensive Examination	3 h	40		OB
QUIZ		15		OB
Assignments/Projects		15		OB

7. Chamber Consultation Hour:To be announced in the class.

8. Notices: All notices concerning the course will be displayed on the mechanical engineering department notice board and online on nalanda.

9. Make-up Policy: Make-up will be permitted only in genuine cases with prior permission. No make-up for class room assignments/quizzes.

10. Note (if any):

Instructor-in-charge

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