

2012-13

**VVP SIDDHARTHA INSTITUTE OF TECHNOLOGY
(COURSE STRUCTURE FOR AUTONOMOUS SCHEME)**

I Year M. Tech. (Machine Design) M.E.

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MEMD1T6A - FRACTURE MECHANICS

(Elective II)

UNIT-I

Principles of Theory Of Elasticity: State of Stress, Stress-Strain relations, Strain-Displacement relations, stress equilibrium equations, Airy's Stress function, Laplace's equation, bi-harmonic Equation, Stresses around a circular hole and an elliptical hole, Inglis's Solution.

UNIT-II

Fracture Failure Modes: Prediction of mechanical failure, Types of Fracture in metals; brittle and Ductile fracture, inter-granular and intra-granular failure, cleavage and microductility, Metallographic aspects of fracture, Characteristics of fracture surfaces, Theoretical Cohesive strength of metals, Dislocation theories, Ductile-to-Brittle Transition, Notch effects.

UNIT-III

Fracture Parameters: Classification of Fracture parameters and their applications; Strain energy release rate (G), Stress intensity factor (K), J-integral (J), Crack tip opening displacement (CTOD).

UNIT-IV

SERR Approach for Linear Elastic Fracture Mechanics: Surface Energy, Griffith's Dilemma, Griffith's Realization, Griffith's analysis, Concept of energy release rate (G), Mathematical Formulation of SERR; Change in compliance and change in strain energy approaches, SERR of DCB specimen and fracture energy (R), Modification for ductile materials, Concept of R curves, Three loading modes, Critical Energy Release Rate.

UNIT-V

SIF Approach for Linear Elastic Fracture Mechanics: State of stress ahead of the crack tip, stress concentration factor, stress intensity factor Field equations, Elementary Properties of Complex Variables, Westergaard's approach for three modes, SIF of complex cases, Relation between G_I and K_I and critical stress intensity factor, The effect of Constraint, definition of plane stress and plane strain, the effect of component thickness, The plasticity at the crack tip and the principles behind the approximate derivation of plastic zone shape and size, Effective crack length, Limits on the applicability of LEFM.

UNIT-VI

J-Integral Approach for Elastic-Plastic Fracture Mechanics: Alternative failure prediction parameter J integral definition, Path independence of J-Integral, Ramberg-Osgood equation, Application to engineering problems, Equivalence of G and J.

UNIT-VII

CTOD Approach for Elastic-Plastic Fracture Mechanics: Alternative failure prediction parameter Crack Tip Opening Displacement definition, Significance, Relationship between CTOD, K, and G, Equivalence between CTOD and J.

UNIT-VIII

Experimental Techniques: Experimental determination of critical stress intensity factor, CT and SENB specimens, Test techniques for determination of critical energy release rate of interlaminar crack for mode I and mode II, DCB and ENFS specimens

Text Books

1. Prashanth Kumar, Elements of Fracture Mechanics, First Edition, Wheeler Publishing, (1999)
2. T.L. Anderson, Fracture Mechanics Fundamentals and Applications, 2nd Ed. CRC press, (1995)
3. G. E. Dieter, Mechanical Metallurgy, McGraw Hill, (1988)
4. Timoshenko & Goodier, Theory of Elasticity, Second Edition, McGraw-Hill book Company, (1951)

