

(ME 505) CREEP, FATIGUE AND FRACTURE MECHANICS

Objective of the Course :

This course helps the students to know the necessary methods of designing components against the failure under creep and fatigue phenomena. It also provides the fracture mechanics principles involved in the latest design procedures.

UNIT – I

Theoretical cohesive strength of metals – Ductile brittle transition of metals - Ductile fracture - Brittle fracture.

Modes of fracture failure - Early concepts of stress concentrators and flaws. Inglis solution to stress round an elliptical hole - Surface energy – Griffiths analysis - Energy release rate - Crack resistance - Stable and Unstable crack growth - R-Curve.

Stress intensity factor for a crack. Stresses and displacement in Cartesian and polar coordinates. Critical stress intensity factor - K_{1C} testing.

UNIT – II

Linear Elastic fracture mechanics - Elastic plastic fracture mechanics - Plastic zone shape for plane stress and plane strain – Effective crack length – Irwin plastic zone correction – Dugdale approach - Effect of plate thickness.

Elastic plastic analysis through J – Integral - Path Independence – J_{1C} testing. Crack tip opening displacement

UNIT – III

FATIGUE : Importance of Fatigue in engineering applications – Low cycle fatigue – Coffin Manson relation – Strain life equation – Structural features of fatigue – Fatigue crack propagation – High cycle fatigue – Basquin's law. Cumulative fatigue damage.

Effect of Metallurgical variables on fatigue – Design for fatigue –Corrosion fatigue – Effect of temperature on fatigue.

UNIT – IV

Crack growth and application of fracture mechanics to fatigue. Paris erdogan law – Effect of an overload – Crack closure – Variable amplitude fatigue load.

Cycle counting methods – Reservoir Method – Rainflow Method.

Fatigue of welded structures – Factors affecting the fatigue lives of welded joints.

UNIT – V

CREEP: Time dependent mechanical behaviour – Creep curve – Effect of stress on creep curves – Stress rupture test – Structural changes during creep – Creep under combined stresses – Creep fatigue interaction.

TEXT BOOKS:

1. Prashant kumar, "Elements of Fracture Mechanics", 2nd Edition, Tata Mc Graw Hill, 2009.
2. George E.Dieter, "Mechanical Metallurgy", 3rd Edition, Mc Graw Hill Publication, 2007.

REFERENCE BOOKS:

1. Anderson T.L, "Fracture Mechanics: Fundamentals and Applications", 2nd Edition, Taylor & Francis Publications, 2005.
2. Broek.D- Martinus, "Elementary Engineering Fracture Mechanics", 1st Edition, Nijhoff publishers, 1982.
3. V.M. Radha Krishnan, "Welding Technology & Design", 2nd Edition, New Age International Publications, 2006.