

## MECHANICAL BEHAVIOUR OF MATERIALS

### Module-I (14 Hours)

Introduction: Theory of elasticity and plasticity, Generalised Hooke's law, stress-strain relationship. Mechanism and crystallography of slip and twinning. Plastic response of materials-a continuum approach: classification of stress-strain curves, yield criteria. Concept of critical resolved shear stress. Deformation of single crystals and polycrystals. Hall –Petch relationship. Role of grain boundaries in deformation, strengthening mechanisms. Dislocation Theory: Elements of dislocation theory, movement of dislocation, elastic properties of dislocation, intersection of dislocation, dislocation reactions in different crystal structures, origin and multiplication of dislocations.

### Module- II (14 Hours)

Fracture: Mode and mechanism of fracture, Griffith's theory, Ductile to brittle transition. Transition temperature phenomena, Factors affecting transition temperature, Fracture mechanism, strain energy release rate, stress intensity factor, plane strain fracture toughness. Fatigue :Fatigue testing methods and machines. Stress controlled and strain controlled fatigue. Analysis of cyclic stress – strain data. Mechanism of fatigue crack, nucleation and propagation. Creep: Generation and analysis of creep and rupture data. Dislocation and diffusion mechanisms of creep. Grain boundary sliding and migration. Deformation mechanism maps. Effect of metallurgical and test variation on creep and fracture. Superplasticity. Parametric methods for prediction of long time properties.

### Module- III (14 Hours)

Tension test- Engineering & true stress-strain curves, evaluation of tensile properties, Tensile instability, Effect of strain-rate & temperature on flow properties. Hardness tests- Brinell, Rockwell, Vickers, Meyer, Knoop, etc., relationship with flow curve. Compression Test- Comparison with tension, phenomenon of buckling & barreling. Bend Test- Pure bending & flexure formula. Impact Test- Notched bar impact tests, transition Temperature & metallurgical factors affecting it.

### Books for reference:

1. Dieter G. E., Mechanical Metallurgy, McGraw-Hill.
2. Hertzberg R.W., Deformation and Fracture Mechanics of Engineering Materials John Wiley.
3. Meyers M. A. and Chawla K. K., Mechanical Behaviour of Materials.
4. Courtney T.H., Mechanical Behaviour of Materials.