PMT4I104 DEFORMATION BEHAVIOUR OF MATERIALS

Module-I (14 Hours)

Introduction: Elastic, plastic and visco-elastic deformation.
Continuum mechanics:Concepts of stress and strain in 3D stress and strain tensor, principal stresses and strains and principal axes, mean stress, stress deviator, maximum shear, equilibrium of stresses, equations of compatibility, Octahedral shear stress and shear strain, Plastic stress-strain relationship.
Elastic behaviour of materials:Constitutive equations in elasticity for isotropic and anisotropic materials, strain energy, elastic stiffness and compliance tensor, effect of crystal structure on elastic constants.
Plastic response of materials:a continuum approach: classification of stress-strain curves, yield criteria.
***Plastic deformation of single crystals*:** Concepts of crystal geometry, lattice defects, deformation by slip, slip in a perfect lattice, slip by dislocation movement, critical resolved shear stress, deformation by twinning, stacking faults, deformation band and kink band, strain hardening of single crystal; stress-strain curves of fcc, bcc and hcp materials.

Module- II (12 Hours)

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, dislocation pile-ups.

Plastic deformation of polycrystalline materials: Role of grain boundaries in deformation, strengthening by grain boundaries, yield point phenomenon, strain ageing, strengthening by solutes, precipitates, dispersoids and fibres.

Module- III (12 Hours)

Fracture:Types of fracture in metals, theoretical cohesive strength of metals, Griffth theory of brittle fracture, fracture of single crystals, metallographic aspects of fracture, dislocation theories of brittle fracture, ductile fracture.
Tension test:Engineering & true stress-strain curves, evaluation of tensile properties, Tensile instability, Effect of strain-rate & temperature on flow properties.
Deformation in non-metallic materials:structure and deformation of polymers, concept Super-lattice dislocations in intermetallics, concept of charge associated with dislocations in ceramics.

Books for reference:

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