MECHANICAL BEHAVIOR OF MATERIALS

Unit-I: PLASTIC DEFORMATION OF CRYSTALS

Strength of materials, Basic assumptions, Elastic and plastic behavior, Average stress and strain, Concept of stress and strain, Types of stresses and strains, Crystals and its defects, Deformation by slip, Slip in a perfect lattice, Slip by dislocation movement, Critical resolved shear stress for slip, Deformation of single crystals and polycrystalline materials, Deformation by twinning, Stacking faults, Strain hardening

Unit-II: DISLOCATION THEORY

Theoretical cohesive strength, Dislocation types, Burger's vector and dislocation loop, Dislocations in FCC, BCC and HCP, Stress fields and energies of dislocations forces on dislocations, Forces between dislocations, Dislocation Climb, Interaction of dislocations, Jogs, Dislocation Sources, Dislocation multiplication, Dislocation pileups, Interaction with points defects.

Unit-III: MATERIALS TESTING-I

Tension Testing: ASTM Standards and specification, Engineering stress & strain, True stress strain curves, Holloman - Ludwig equation, Plastic Instability (Necking), Testing machines-types, testing procedures, properties measured, specimen dimensions; ***Hardness Testing:*** Brinell hardness testing, Rockwell hardness testing, Vickers hardness testing and knoop hardness testing, Shore and Poldi methods, Nano indentation: ***Torsion Testing & Shearing Test:*** ASTM Standards and specification Testing Machines and procedures; ***Impact Testing:*** Principle, Izod and Charpy Impacts tests, ASTM Standards and specification. Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, determination of DBTT.

Unit-IV: FRACTURE MECHANICS

Fracture Types of fracture, Griffith Theory and modified Griffith-Orowan theory, metallographic aspects of fracture, crack propagation, concept of fracture curve, Fracture toughness KIC Testing, JIC testing, Concept of R curve and J integral.

Unit-V: MATERIALS TESTING-II: FATIGUE

Introduction, Stress Cycles, The S-N Curve, Statistical Nature of Fatigue, Effect of Mean Stress on Fatigue, Cyclic Stress-Strain Curve, Low-Cycle Fatigue, Strain-Life Equation, Structural

Features of Fatigue, Fatigue Crack Propagation, Effect of Stress Concentration on Fatigue, Size Effect, Surface Effects, Fatigue under Combined Stresses, Cumulative Fatigue Damage and Sequence Effects, Effect of Metallurgical Variables, Design for Fatigue, Corrosion Fatigue, Effect of Temperature on Fatigue

Unit-VI: MATERIALS TESTING-III: CREEP AND STRESS RUPTURE

The High-Temperature Materials Problem, Time Dependent Mechanical Behavior, The Creep Curve, The Stress-Rupture Test, Structural Changes During Creep, Mechanisms of Creep Deformation, Deformation Mechanism Maps, Activation Energy for Steady-State Creep, Superplasticity, Fracture at Elevated Temperature, High-Temperature Alloys, Presentation of Engineering Creep Data, Prediction of Long-Time Properties, Creep Under Combined Stresses, Creep-Fatigue Interaction

REFERENCE BOOKS

1. George E Dieter, “Mechanical Metallurgy", Mc Graw Hill, Singapore, 1995.
2. Hull D and Bacon D J, “Introduction to dislocations”, Butterworth Heinemann, Oxford, 2001.
3. Wullf et al, Vol. III “Mechanical Behavior of Materials", John Wiley and Sons, New York, 1983.
4. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", John Wiley and Sons, 1976.
5. J. Roesler, H. Harders, and M. Baeker, "Mechanical Behaviour of Engineering Materials: Metals, Ceramics, Polymers, and Composites", Springer-Verlag, 2007.
6. Thomas H. Courtney, "Mechanical Behavior of Materials", McGraw-Hill, 1990.