

I Year M.Tech (MACHINE DESIGN) FIRST SEMESTER

17MEMD1T2

MECHANICAL BEHAVIOR OF MATERIALS

Credits 4

Lecture: 4 periods/week

Internal assessment: 40 marks

Tutorial: - -

Semester end examination: 60 marks

COURSE OBJECTIVES:

- To familiarize with different advanced materials and their properties.
- To know the mechanical behavior of materials under different loading and temperature conditions.

COURSE OUTCOMES:

At the end of the course, the student will be able to

1. Establish basic concepts in Mechanical behavior of different materials.
2. Understand the basic concept of Strain hardening, Fatigue, and Creep mechanisms.
3. Understand the basic principle of Microscopy and SEM, TEM for material characterization.
4. Understand the fracture behavior of ductile and brittle materials.

UNIT-I

INTRODUCTION: Overview of the course, examination and evaluation patterns, history and Introduction to Mechanical behaviour of Materials.

FUNDAMENTAL CONCEPTS: Mechanical properties of materials, stress and strain, Mohr's strain circle, Elasticity, plasticity, Tensile Testing, stress-strain curve for ductile, brittle and polymer materials, Bridgman correction, Other tests of plastic behavior.

UNIT-II

STRAIN HARDENING: Strain hardening of metals, Strain rate and Temperature dependence, Hardening mechanisms in metals- strain hardening, solid solution strengthening, dynamic strain ageing.

FATIGUE, AND CREEP MECHANISMS: S-N curves, Statistical nature of fatigue, Structural features of fatigue, fatigue crack propagation, effect of mean stress, stress concentration, design estimates, cyclic stress strain behavior, slip system, Creep mechanisms, temperature dependence of creep, Structural changes during creep, Mechanism of creep deformation, Creep under combined stresses, Creep fatigue interaction.

UNIT-III

MECHANICAL BEHAVIOUR OF OTHER MATERIALS: Mechanical behavior of ceramics, glasses, polymers and Composites: FRP and MMC, Material characterization using optical microscopy, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM).

UNIT-IV

BRITTLE FRACTURE: Significance of transition, Temperature curve, Metallurgical factors affecting transition Temperature , Fracture Analysis diagram, Temper embrittlement, Environment Sensitive fracture-Hydrogen embrittlement, Stress-corrosion cracking, Liquid-metal embrittlement, Neutron embrittlement, Flow and fracture under very rapid rates of loading..

Learning Resources

Text Books:

1. Mechanical Metallurgy (2nd Edition) by George E. Dieter, Mc Graw Hill, 2005.
2. Engineering Mechanics of Composite Materials (2nd edition) by Isaak M. Daniel, Ori Ishai, Oxford university press, , 2006.

Reference Books:

1. Introduction to Fracture Mechanics by Hellan K, Mc Graw Hill, 2002.
2. Mechanical behaviour of materials at elevated temperatures by J.E.Dorn, , McGraw Hill, 2000.