B.Tech III Year II Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

19AME64e – MECHANICAL BEHAVIOUR OF MATERIALS

(Professional Elective-II)

L	T	P	C
3	0	0	3

Course Objectives: The objectives of the course are to make the students learn about

- Explain the structure of material over the effects of mechanical properties.
- Familiarize the defects inside the structure and their effects on the mechanical properties.
- Train the methods for characterization of the mechanical behavior of materials.
- Impart knowledge about strengthening mechanisms of materials.
- Teach mechanisms of failures of materials (fracture, fatigue and creep) and their relationship with the different types of stress.

UNIT – I: Elastic and plastic behavior **10 Hrs**

Elastic behaviour of materials – Hooke's law, plastic behavior: dislocation theory – Burger's vectors and dislocation loops, dislocations in FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, slip and twinning.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the elastic behavior of engineering materials. **L2**
- Recall Hooke's law. **L1**
- Explain the dislocation theory. **L2**
- Identify the dislocations in FCC, HCP and BCC lattice. **L3**
- Determine the forces on and between dislocations. **L3**

UNIT – II: Strengthening mechanisms **10 Hrs**

Cold Working, Grain Size Strengthening, Solid Solution Strengthening, Martensitic Strengthening, Precipitation Strengthening, Dispersion Strengthening, Fibre Strengthening, Examples. Yield Point Phenomenon, Strain aging and Dynamic strain aging.

Learning Outcomes:

At the end of this unit, the student will be able to

- Describe various strengthening mechanisms. **L2**
- Discuss grain size strengthening and solid solution strengthening. **L6**
- Apply dispersion strengthening and fibre strengthening. **L2**
- Differentiate strain aging and dynamic strain aging. **L3**

UNIT – III: Fracture and fracture mechanics **10Hrs**

Types of Fracture, Basic Mechanism of Ductile and Brittle Fracture, Griffith's Theory Of Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Factors Affecting DBTT, Determination of DBTT. Fracture Mechanics-Introduction, Modes of Fracture, Stress Intensity Factor, Strain Energy Release Rate, Fracture Toughness and Determination of K_{IC}.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the basic mechanism of ductile and brittle fracture. **L2**
- Identify importance of Griffith's Theory. **L3**
- Predict factors effecting on DBTT. **L6**
- Classify various modes of fracture. **L1**

UNIT – IV: Fatigue behaviour and testing **8 Hrs**

Stress Cycles, S-N Curves, Effect of Mean Stress, Factors Affecting Fatigue, Structural Changes Accompanying Fatigue, Cumulative Damage, HCF / LCF, Thermo-mechanical Fatigue, Application of Fracture Mechanics to Fatigue Crack Propagation, Fatigue Testing Machines.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain fatigue behaviour and testing. **L2**
- Draw the S-N curves for different materials. **L1**
- Discuss the factors affecting fatigue. **L6**
- Apply fracture mechanics in design. **L2**

UNIT – V: Creep behaviour and testing **8 Hrs**

Creep Curve, Stages In Creep Curve And Explanation, Structural Changes During Creep, Creep Mechanisms, Metallurgical Factors Affecting Creep, High Temperature Alloys, Stress Rupture Testing, Creep Testing Machines.

Learning Outcomes:

At the end of this unit, the student will be able to

- Identify various stages in creep curve. **L3**
- Determine various structural changes during creep. **L4**
- Predict the metallurgical factors affecting creep. **L6**
- Demonstrate various creep testing machines. **L2**

Text Books:

1. Dieter, G.E., "Mechanical Metallurgy", McGraw-Hill, SI Edition, 1995.
2. Davis. H. E., Troxell G.E., Hauck.G. E. W., "The Testing Of Engineering Materials", McGraw-Hill, 1982.

Reference Books:

1. Wulff, The Structure and Properties of Materials, Vol. III "Mechanical Behavior of Materials", John Wiley and Sons, 1983.
2. Honey Combe R. W. K., "Plastic Deformation of Materials", Edward Arnold Publishers, 1984.
3. Suryanarayana, A. V. K., "Testing of Metallic Materials", Prentice Hall India, 1979.

Course Outcomes:

At the end of this Course the student will be able to

- Apply materials based on their structure and failure modes **L2**
- Characterize materials using different machines **L3**
- Summarize the various strengthening mechanisms with suitable examples **L2**
- Identify the creep in different materials and its influence in selection of materials **L3**

Head
Mechanical Engineering Department,
JNTUA College of Engineering,
PULIVENDULA - 516 390.