Course code	Course Name	L-T-P - Credits	Year of Introduction
MT208	MECHANICAL BEHAVIOUR AND TESTING	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To provide an understanding of mechanical behavior of materials under various loading conditions and fundamental methods of mechanical testing for property determination.

Syllabus

Elastic and Plastic Behavior - Concept of stresses and the type of stresses - Concept of strain and types of strain - Stress and Strain Relationship for Elastic Behavior - Mohr's Circle of stresses- two and three dimensions -Mohr Circle of strain- Elastic stress-strain relation - Basic of Theory of Plasticity - True stress and True strain - Yielding criteria for ductile metals - Octahedral shear stress and shear strain - Invariants of stress and strain- Strengthening Mechanism - Strain hardening – super plasticity. Recovery, recrystallization and grain growth - Mechanical Testing- Tension/compression test -Hardness tests- Creep test- Torsion tests - Fatigue tests - Notched Bar Impact Testing, ductile-Brittle Transition Temperature (DBTT). Metallurgical factors affecting DBTT

Expected Outcome.

At the end of this course, the students would be able to:

i. Have the concept of stress and strain in materials and the units
ii. Understand stress and strain relationship for elastic behavior, Mohr's Circle of stresses and strains, problems for calculation of stresses from elastic strains.
iii. Have the concept of plastic yielding and the various criteria for yielding. Ability to solve problems connected with plastic yielding
iv. Understand concepts of crystal geometry, plastic deformation by slip and twinning and strain hardening behavior of single crystals.
v. Understand various strengthening mechanisms in metals and alloys, texture, superplasicity, recovery, recrystallization and grain growth behavior.
vi. Carryout different types of mechanical tests to estimate various mechanical properties and understand the factors influencing the properties.

References/Textbooks

1. Dieter G.E. Mechanical Metallurgy, McGraw Hill Book Company
2. Honeycomb RWK., The Plastic Deformation of Metals
3. Joachim Roesler et al, Mechanical Behavior of Engineering Materials, Springer
4. William F. Hosford, Mechanuical Behaviour of Materials, Cambridge University Press
5. Meyers. M.A, Chawla. K.K, Mechanical Behaviour of Materials
6. Dowling. N.E, Mechanical Behavior of Materials, Prentice Hall
7. Davis H.E et al, Testing and Inspection of Engineering Materials, McGraw-Hill
8. Suryanarayana A.V.K, Testing of materials, BS Publications, New Delhi

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Deformation Concept :** 1.1 Strength of Materials – Basic assumptions, 1.2 Elastic and Plastic Behavior, 1.3 Average stress and strain, 1.4 Tensile deformation of ductile metal, 1.5 Ductile Vs Brittle Behavior, 1.6 Types of failures, 1.7 Concept of stresses and the type of stresses, 1.8 Concept of strain and types of strain, 1.9 Units of stress and other quantities	6	15%

II	**Stress and Strain Relationship for Elastic Behavior** 2.1 Description of stress at a point, 2.2 State of Stress in two dimensions (plane stress), 2.3 Mohr's Circle of stresses-two dimensions, 2.4 State of stress in three dimensions 2.5 Mohr' Circle-three dimensions, 2.6 Description of strain at a point-Mohr Circle of strain, 2.7 Hydrostatic and Deviator components of Stress, 2.8 Elastic stress-strain relation, 2.9 Calculation of stresses from elastic strains 2.10 Problems.	7	15%
FIRST INTERNAL EXAMINATION			
III	**Basic of Theory of Plasticity** 3.1 Flow curve, 3.2 True stress and True strain, 3.3 Yielding criteria for ductile metals, 3.4 Von-Mises' criterion, Tresca Criterion, Problems, 3.5 The yield locus, 3.6 Octahedral shear stress and shear strain, 3.7 Invariants of stress and strain.	6	15%
IV	**Strengthening Mechanism (5 Hrs)** 4.1Strengthening from grain boundaries, 4.2 Strain ageing, 4.3 Solid solution strengthening, 4.4 Strengthening of two phase aggregate, 4.5 Strengthening from fine particles, 4.6 Strain hardening, superplasicity.4.7 Recovery, recrystallization and grain growth	5	15%
SECOND INTERNAL EXAMINATION			
V	**Mechanical Testing-1** 5.1 Tension/compression test: Stress–strain diagram, necking and fracture. 5.2 Analysis of stress- strain diagram, work hardening index. effect of strain rate and temperature on flow properties, 5.3 Notch tensile test notch strength ratio (NSR). 5.4 Hardness tests: Vickers, Rockwell, Brinell, Meyer, Knoop and micro hardness tests. 5.5 Relation between various systems of hardness numbers, relation of hardness to tensile strength. Hardness at elevated temperatures, 5.6 Creep test: Creep curve, effect of stress and temperature on creep curve, . 5.7 Torsion tests: Mechanical properties in torsion, modulus of rupture, modulus of rigidity types of torsion failures, torsion test vs tension test, hot torsion testing.	9	20%
VI	**Mechanical Testing-2** 6.1 Fatigue tests: Types of cyclic load, characteristics of fatigue failure, S-N curves, factors affecting fatigue strength and methods of improving fatigue behavior, 6.2 Low cycle fatigue: Coffin-Manson relation, strain-life equation, fatigue crack propagation-Paris law, 6.3 Notched Bar Impact Testing: Charpy & Izod impact testing, ductile-Brittle Transition Temperature (DBTT). Metallurgical factors affecting DBTT	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks : 100 Exam Duration: 3 houMaximum Marks : 100 Exam Duration: 3 hrs
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PART A: 8 Questions from Module 1&2 (4+4). 6 questions to be answered. 6x5=30 Marks
PART B: 8 Questions from Module 3&4 (4+4). 6 questions to be answered. 6x5= 30 Marks
PART C: 6 Questions from Module 5&6 (3+3). 4 questions to be answered. 4x10=40 Marks