Mechanics of Materials

Code	Credit Hours
ME- 228	3-1

Course Description

The objectives of the course are to cover the techniques that allow engineers to design machine components, mechanism, predict failure and understand the physical properties of material. It covers the calculation of stress, strain, deformation that are produced during different applied loads including tension, compression, torsion, bending and combined loading in beams, columns, shafts, and trusses. The concepts of stress transformation using Mohr Circle and principal stresses are also covered. Engineering design concepts are also integrated in this course. The experiments will cover the understanding of fundamental concepts of material testing, component and structure analysis and composite materials testing. The specimen preparation of metallographic specimen & inspection using optical microscope is also covered in the experiments.

Text Book:

1. “Beer, F. P., et al. "Mechanics of Materials. Latest Available Edition." New York. McGraw-Hill Education Ltd
2. Hibbeler, Russell Charles. Mechanics of materials, Latest Available Edition Pearson Co.
3. Materials and Hardware by Aviation Maintenance Technician Certification Series, Latest Available Edition

Reference Book:

1. “Archie Higdon et al “Mechanics of Materials” by, 4thEdition, John Wiley & Sons Inc., 1985.
2. Arthur P Boresi “Advanced Mechanics of Materials”, 6th Edition, John Wiley &Sons Inc., 2003

Prerequisites

MECH 204 (Material Science and Engineering)

ASSESSMENT SYSTEM FOR THEORY

Quizzes	10%
Assignments	10%
Mid Terms	30%
ESE	50%

ASSESSMENT SYSTEM FOR LAB

Quizzes	10%-15%

Assignments	5% - 10%
Lab Work and Report	70-80%
Lab ESE/Viva	20-30%

Teaching Plan

Week No	Topics	Learning Outcomes
1	Introduction	Course Outline, objectives, teaching plan, assessment method, concepts review
2-6	Stress Strain and Deformation	Introduction to load and its classification, Concept of stress, Stress in the member of a structure Stresses on oblique plane, stress under general loading condition, Design considerations Introduction to stress-strain, statically indeterminate problems, problem involving temperature Poisson ratio, Generalized Hooks law Factor of Safety and allowable stresses, shearing strain, plastic deformation, deformation under axial loading
6	**MID TERM IN WEEK 9**	
7-8	Torsion, Bending, BM diagram, Energy Theories.	Polar moment of inertia, Circular shaft under torsion, angle of twist, statically indeterminate shafts, design of shaft, hollow shaft, Moment of inertia for area about x, y, xy planes, symmetric member in pure bending, stresses and deformation in the elastic range beams, deformation in transverse cross section. Revision of SF and BM diagram, Relationship b/w load SF and BM, design of prismatic beam for bending, Von Mises Theory, Energy Distortion
9	**MID TERM EXAM**	
10-12	Torsion, Bending, BM diagram, Energy Theories.	Polar moment of inertia, Circular shaft under torsion, angle of twist, statically indeterminate shafts, design of shaft, hollow shaft, Moment of inertia for area about x, y, xy planes, symmetric member in pure bending, stresses and deformation in the elastic range beams, deformation in transverse cross section. Revision of SF and BM diagram, Relationship b/w load SF and BM, design of prismatic beam for bending, Von Mises Theory, Energy Distortion
13-17	Shear stress in Beams, Mohr Circle, Principal Stress, Design of Shafts	Horizontal shearing stress, longitudinal shear in beams, thin-walled beams Transformation of plane stresses, General state of stress, Mohr Circle, 3- D analysis of stress, stresses in thin-walled pressure vessels principal stresses in beam, design of transmission shaft based in

		principle stresses. Polar moment of inertia, Circular shaft under elastic torsion, angle of twist, design of shaft, hollow shaft Inelastic torsion of straight cylindrical shafts, statically indeterminate shafts, Fatigue Failure and Design, Fatigue life estimation and damage accumulation methods
18	**End Semester Exams**	

Practical:

Experiment No	Description
1	Tensile test of different materials anddetermination of modulus of Elasticity
2	To measure the impact strength via notchedbar Charpy impact test.
3	To observe and calculate the creep behavior of material.
4	Hardness test on Metallic materials
5	Fabricating of composite samples throughhand layup method.
6	Verification of shear force and bending moment equilibrium
7	Torsion test of bars on digital torsion testing machine, strain measurement of Torsional Shaft using strain gauges and determination of modulus of Rigidity
8	Beam deflection under flexural loading usingstrain gauges.
9	Torsion of a thin-walled box beam.
10	Lab on Buckling of Columns
11	Determination of Shear Centre position for achannel and a semi-circular section.
12	Exp # 1 Shear Web Apparatus. (Thin).
13	Exp # 2 Shear Web Apparatus. (Thick)
14	Stress concentration measurement in a beam
15	Preparation of Metallographic Specimen & Inspection using optical microscope(Demonstration Only)
16	Fatigue testing of metallic sample(Demonstration Only)