Department of Civil Engineering

Course Name:

Mechanics of Materials I

Course Number: 20-111	**Credit:** 3
Program: Undergraduate	**Course Type:** Technical required
Prerequisite: Statics	**Corequisite:** -

Course Description (Objectives):

The main objective of the study of the mechanics of materials is to provide the future engineer with the means of analyzing and designing various machines and load-bearing structures. Mechanics of Materials gives the student basic tools for stress, strain and deformation analysis. At the completion of the course, students would be able to analyze and design components and structural members subjected to tension, compression, torsion, bending and combined loads using fundamental concepts of stress and strain with elastic and inelastic behavior.

Course Content (outline):

- **Chapter 1. Introduction**

A brief review on Statics and the aim of Mechanics of Materials.

- **Chapter 2. Stress**

General concept, Definition, Equilibrium equations, Stress analysis of axial loaded bar, Normal and shear stresses, Bearing stress, Single and double shear connections, Design criteria.

- **Chapter 3. Strain**

Normal stress-strain relationship, Hook's law, Poisson's ratio, Shear stress-strain relationship, Generalized concept of strain and Hook's law, Statically indeterminate system.

- **Chapter 4. Torsion**

Equilibrium equation for torsion problems, Torsion formula, Shear stress-torsion relationship for circular members, Design of circular member under torsion, Angle of twist of circular member, Statically indeterminate problems, Torsion of non-circular member, Torsion of thin walled member, Shaft coupling.

- **Chapter 5. Beams (pure bending moment)**

Review of beam problem, Calculation of beam reactions, P, V, M diagrams, Calculation of moment of inertia, Stress of bending moment, Beams of composite cross section.

- **Chapter 6. Shear stresses**

Review of differential equations of equilibrium for a beam element, Shear flow, Shear stress-shear force formulation for beam, Shearing flow in flange and web cross-section, Shear center.

- **Chapter 7. Combined stresses**

Stress combination of axial loading, bending moment, torsion, and shear force, Unsymmetric beam bending, Bending of double symmetric cross section, Beams with arbitrary cross section.

- **Chapter 8. Stress transformation**

Principal stresses, Maximum shearing stresses, Stress transformation, Mohr's circle of stress, Construction of Mohr's circle of stress.

- **Chapter 9. Inelastic and plastic material behavior**

Stress-strain relationship, Hardening, softening, ideal plasticity, Statically indeterminate nonlinear problems, Application to inelastic axial members, torsion of inelastic circular bars, bending of inelastic beams.

References:

- E.P. Popov, Engineering Mechanics of Solids, *Prentice Hall*, 2nd Edition, 1998.
- F.P. Beer, E.R. Johnston, J.T. Dewolf, D.F. Mazurek, Mechanics of Materials, *McGraw Hill*, 6th Edition, 2012.