Aerospace Engineering **Division:**
Level and Major:

Course Title: Strength of Materials **Number of Credits:** **Prerequisite:**
Lecturer: Prof. H. Hosseini-Toudeshky

Course Description: Chapters:

1. Introduction to strength of materials

a. Importance of subject
c. Notion of stress – normal stress, shear stress and bearing stresses
d. Stresses on inclined plane in an axial member
e. Notion of strain – normal strain, shear strain
f. Mechanical properties – elasticity, plasticity, creep, fatigue, etc.
h. Statically indeterminate problems

2. Axial force-Shear-and Bending moment

a. Introduction
b. Classification of beams and calculation of beam reactions
c. Application of method of section
d. Shear, axial force and bending moment diagrams

3. Stress-Axial Loads

a. Definition of stress
b. Stress at a point – matrix of stress / stress tensor
c. Symmetry of stress tensor
c. Average normal and shearing stresses
d. Allowable stress; safety factor
e. Axially loaded problems

4. Strain-Hooke's law-Axial Load Problems

a. Definition of strain – shear and normal strains
b. Strain at a point, strain tensor and symmetry of strain tensor
c. Stress-Strain diagram
d. Hook's law, Poisson's ratio, Generalized Hooke's law
e. Shearing stresses on perpendicular planes
f. Hooke's law for shearing stress and strain
g. Stress concentrations
h. Strain energy in axial load problems

5. Torsion

a. Introduction, basic assumptions
b. Deriving of Torsion formula
c. Application of circular members in torsion
d. Angle of twist in circular members
e. Shearing stresses and deformations in elastic-plastic behaviour
d. Stress concentrations
e. Torsion of noncircular members
f. Thin-walled hollow members
g. Shaft Coupling

6. Pure Bending of Beams

a. Introduction, Pure bending of beams
b. Basic assumptions and limitation of the theory
c. Flexure formula for pure bending of beams with symmetric cross-sections
d. Pure bending of beams with asymmetric cross-sections
e. Bending of beams under elastic-plastic behaviour
f. Beams with composite (two material) cross-section
g. Stress Concentrations
h. Curved beams under bending

7. Shearing Stresses in Beams

a. Relation between shear load and bending moment
b. Shear flow
c. Shearing stress formula for beams
d. Remarks on shearing stresses distributions
e. Application examples and various problem solving
f. Shear center

8. Multiaxial Stress Problems, plane stress and plane strain conditions, and Failure Theories

a. Different states of stress – uniaxial, biaxial, plane stress, etc.
b. States of stress in some applications, Thin-walled pressure vessels
c. Complex loading conditions
d. Transformation of plane stress; extension to 3-D
e. Principal stresses and maximum shear stress
f. Mohr's circle of stress
g. Analyses of plane strain
h. Transformation of plane strain; extension to 3-D.
i. Principal strains
j. Mohr's circle of strain
k. Energy methods- Multiaxial stresses conditions
l. Failure theories
- Maximum normal stress theory
- Maximum shearing stress theory
- Maximum distortion energy theory (Von Mises)
- Comparison of failure theories and applications

9. Compound stresses

a. Superposition and its limitations
b. Combined state of axial loading and bending moment
c. Eccentric loading
d. Kern of Section
e. Axial loading of materials with no tensile strength

Course Goals and Objectives:

١. To give an ability to calculate stresses of components under various combined sectional forces/moments and external loadings

٢. To give an ability to apply the knowledge of strength of materials on engineering applications and design problems.

3. To build the necessary theoretical background for further structural analysis and design courses.

Reading Resources:

- E.P. Popov, 1998, Engineering Mechanics of Solids, 2nd Edition, Prentice-Hall.
- Suggested: F. Beer, Jr., E.R. Johnston, J. DeWolf, D. Mazurek, 2012, Mechanics of Materials, 6th Edition McGraw-Hill.
- Suggested: R.C. Hibbeler, Mechanics of Materials, 2013, 9th Edition, Pearson Prentice Hall,

Evaluation: