ENGR 140: MECHANICS OF MATERIALS

Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2023
Credits:	4
Total Contact Hours:	72
Lecture Hours :	72
Lab Hours:	0
Hours Arranged:	0
Outside of Class Hours:	144
Prerequisite:	ENGR 135.
Strongly Recommended:	ENGL 101.
Transferable to CSU:	Yes
Transferable to UC:	No
Grading Method:	Standard Letter

Catalog Course Description

Mechanics of deformable bodies that are subjected to loads such as tension, compression, bending, shearing and torsion. Subjects include combined stresses, strain, Mohr's Circle, statically indeterminate structures, deflection of beams, stability of columns and strain energy methods. Hooke's Law for isotropic materials and shear and moment diagrams will also be studied. 72 lecture hours.

Course Objectives

- Apply fundamentals of statics to determine reactions at supports.
- Perform stress analysis of shaft and beams.
- Evaluate deflection of beams and shafts.
- Analyze pressure vessel stresses.
- Analyze axial loading on columns.
- Analyze structures subjected to normal, shearing, torsional and bending stresses.
- Use strain gauge data to obtain normal stresses.
- Determine the forces applied on each structural member of a system and the internal forces and couples at internal sections.
- Use Mohr's Circle to graphically determine the stress components acting on a rotated coordinate system.
- Determine if a structural system meets its design specifications and determine how the system will fail.
- Use strain energy to determine modulus of resilience and modulus of toughness.
- Determine both the stress distribution and the angle of twist when a material behaves in a linear elastic manner and also when it is in elastic.
- Properly develop a shear and moment diagrams to calculate bending stress.
- Determine the effects of combined loadings.
- Identify and calculate principal stresses and maximum in-plane shear stress.

Major Course Content

1. Review of statics and factor of safety
2. Stress and Strain
   a. Equilibrium of a deformable body
   b. Average normal stress
   c. Normal stress-strain curves, Young's Modulus, Poisson's Ratio and energy density
   d. Shear stress-strain curves, shear modulus
   e. Plane stress and plane strain
   f. three-dimensional (3D) stress-strain relationship
3. Mechanical properties of materials
   a. Tension and compression test
   b. Stress-strain behavior of ductile and brittle materials
   c. Hook's law
   d. Strain energy
   e. Poisson's ratio
4. Axial members
   a. Members with constant internal force, area, and material
   b. Saint-Venant's principle
   c. Superposition
   d. Thermal stress
   e. Members with discontinuous internal force and area
   f. Determining movement using displacement methods
   g. Statically indeterminate methods
5. Torsional members
   a. Torsional deformations and the torsion formula
   b. Power transmission
   c. Angle of Twist
   d. Statically indeterminate methods
6. Bending and transverse shear
   a. Shear and moment diagrams
   b. Bending stress
   c. Beam displacement
   d. Shear stress
   e. Shear center
7. Combined loads and stresses
   a. Pressure vessels
   b. Combined loading stress
8. Stress transformation
   a. Transformation equations
   b. Principle stresses and maximum shear stress
   c. Mohr's circle - plain stress
   d. Absolute maximum shear stress
9. Stain transformation
   a. Transformation equations
   b. Maximum shear strain
   c. Mohr's circle - plain strain
   d. Strain rosettes
10. Beams and shafts
    a. Basis for beam design
    b. Prismatic beam design
    c. Elastic curve
    d. slope and displacement by integration

e. Method of super position
f. Statically indeterminate beams and shafts methods

11. Column buckling
    a. Critical load
    b. Ideal column with pin supports
    c. Columns with various types of support
    d. Secant formula

Suggested Reading Other Than Required Textbook

Articles from ASME, SAE, AIAA or similar professional engineering journals or periodicals.

Examples of Required Writing Assignments

Write short answer responses relating concepts learned to examples given in the textbook.

Examples of Outside Assignments

Answer end of chapter questions: 1. For the lap joint shown, compute the largest permissible load which will not cause failure of the joint. 2. Calculate the stress in the given structural member due to thermal expansion. 3. Draw and label shearing force and bending moment diagrams for the beam shown. 4. Determine maximum deflection of the beam shown. 5. For the column shown, determine the maximum load that can be applied without causing buckling.

Instruction Type(s)

Lecture, Online Education Lecture