Lehigh University
Department of Mechanical Engineering and Mechanics
Mech 12 - Strength of Materials

Learning Objectives / Educational Outcomes

Upon completion of this course, students should be able to:

1. Execute precise arithmetic calculations, employing consistent units of geometry, force, moment, displacement, stress, and strain in both SI and U. S. customary unit systems.

2. Determine both normal and shearing stresses in simple beam and beam-like structures; utilize stress analysis information to design application specific beam cross-sections.

3. Understand the concept of stress transformation and how to determine principal stresses.

4. Apply plastic yield criteria to the design of structures subjected to multi-axial stress states.

5. Design thin-walled cylinders and spheres to withstand safe internal pressure loading.

6. Compute the state of stress in the cross-section of a three-dimensional structure subjected to three-dimensional force and moment vectors.

7. Compute beam displacements for general loading on slender beams.
   (a) Understand derivative relationships between distributed load, shear, and moment.
   (b) Integrate load equations to compute the slope and deflection in beams.
   (c) Use deflection equations to solve for loads and stresses in statically indeterminate beams.

8. Utilize the finite element method to analyze stress and deformation in rods, truss structures and beams.

9. Construct a computer code to implement a finite element solution for a one-dimensional rod of varying cross-section.

10. Employ a commercial FEM software package to design and optimize a bridge structure within specified stress and deflection constraints.

11. Understand the importance of stress concentrations and determine the maximum stresses at fillets and holes subjected to extension, bending, and torsion.

12. Calculate deformation and stresses in thick-walled cylinders and disks.

13. Use energy methods to compute the strain energy in a structure due to centric axial loading, shear, and bending.

14. Use energy methods to analyze maximum stress during impact.