San Francisco State University  
Civil and Mechanical Engineering

**Course Outline**  
**ENGR 309: Mechanics of Solids**

**Bulletin Description:**  
ENGR 309  Mechanics of Solids  
Prerequisites: ENGR 102 and 200  

**Textbook:**  

**Coordinator:**  
Timothy D'Orazio, Professor of Civil Engineering

**Prerequisites by Topic:**  
2. Application of the equations of static equilibrium.  
3. Mechanical properties of engineering materials, particularly steel and other metals.  
4. Solution of 2nd order differential equations and integration.  
5. Centroids and moments of inertia.

**Course Objectives:**

1. Enhance student understanding of mechanical properties of solid materials. [A.1, A.2]
2. Enable students to determine internal forces in common civil and mechanical engineering components. [A.1, A.2, B.1, B.4]
3. Develop student understanding of stresses and strains created in components due to various loads. [A.1, A.2, B.1, B.4]
4. Develop student understanding of deformation of common components. [A.1, A.2, B.1, B.4]
5. Acquaint student with the concept of stability. [A.1, A.2, B.1]

**Topics:**  
1. Basic concepts of stress and strain.  
2. Stresses in bodies subject to axial, torsional, and pressure loads.  
3. Forces and stresses in beams.  
4. Beam deflection,  
5. Transformation of stress and strain.  
7. Introduction to column stability.

**Professional Component**  
| Engineering Sciences | 100% |

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1 Indexes in brackets refer to “Objectives and Outcomes” for the School of Engineering.
Evaluation
1. Weekly Quizzes
2. Final exam

Performance Criteria:

Objective 1: Enhance student understanding of mechanical properties of solid materials.
1.1 Student understands the basic mechanical properties represented by a stress-strain diagram for typical metals and brittle materials. [2, 3, 4]
1.2 Student knows and understands the generalized Hooke’s law. [1, 2, 3, 4]

Objective 2: Enable students to determine internal forces in common civil and mechanical engineering components.
2.1 Student can obtain internal forces in prismatic bars under axial loads. [1, 2, 3, 4]
2.2 Student can obtain internal torsion in circular shafts due to torsional loads. [1, 2, 3, 4]
2.3 Student can obtain shear and bending moment in prismatic beams due to bending loads. [1, 2, 3, 4]
2.4 Student can obtain reactions for statically indeterminate rods, shafts and beams. [1, 2, 3, 4]

Objective 3: Develop student understanding of stresses and strains created in components due to various loads.
3.1 Student can compute stresses and strains in rods due to axial loads. [1, 2, 3, 4]
3.2 Student can compute stresses and strains in solid and hollow shafts due to torsion. [1, 2, 3, 4]
3.3 Student can compute stresses and strains in pressure vessels. [1, 2, 3, 4]
3.4 Student can compute stresses and strains in prismatic beams due to shear and bending moment. [1, 2, 3, 4]
3.5 Student is able to transform stress and strain from one set of axes to another. [1, 2, 4]
3.6 Student is able to use Mohr’s circle to obtain principal stresses. [1, 2, 4]
3.7 Student is able to use stress to select beam section. [1, 2, 4]

Objective 4: Develop student understanding of deformation of common components.
4.1 Student can calculate beam deflection using integration and superposition. [1, 2, 4]

Objective 5: Acquaint student with the concept of stability.
5.1 Student can use Euler’s formula to evaluate the stability of long columns. [1, 4]

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2 Numbers in brackets refer to evaluation method used to assess student performance.