# COURSE OUTLINE

| Course Number | Course Title | Credits |
|---|---|---|
| **CIV230** | **Mechanics of Solids** | **4** |
| **Hours: Lecture/Lab/Other** | **Co- or Pre-requisite** | **Implementation Semester & Year** |
| **3/3/0** | **MAT151 and CIV103. Both with a minimum C grade** | **Fall 2022** |

**Catalog description:**
Calculus-based introduction to engineering materials and their mechanical properties, examining strains that occur in elastic bodies subjected to direct and combined stresses, shear and bending moment diagrams, deflections of beams, and stresses due to torsion. Lab testing involves various materials such as cast iron, steel, brass, aluminum, and wood to determine their physical properties and demonstrate various testing techniques.

**General Education Category:**
Not GenEd

**Course coordinator:**
James Maccariella, 609-570-3462, maccarij@mccc.edu

**Required texts & Other materials:**

Statics and Mechanics of Materials, latest edition
Ferdinand P. Beer, E. Russell Johnston, John T. DeWolf, David F. Mazurek
McGraw Hill
ISBN13: 9781260226751

**Course Student Learning Outcomes (SLO):**

***Upon successful completion of this course the student will be able to:***

1. Demonstrate basic engineering materials terminology. [Supports ILG 1; PLO 5, 6, 7]
2. Demonstrate the relationship between external forces member reactions. [Supports ILG 1, 2; PLO 5, 6, 7]
3. Analyze various types of materials problems. [Supports ILG 2, 11; PLO 5, 6, 7]
4. Generate and interpret loading diagrams. [Supports ILG 2, 11; PLO 5, 6, 7]
5. Solve problems in a well-organized and logical manner. [Supports ILG 2, 11; PLO 5, 6, 7]
6. Complete laboratory testing of various materials to determine their physical properties. [Supports ILG 1, 11; PLO 5, 6, 7]
7. Demonstrate the relationship of engineering materials to the study of advanced topics in engineering. [Supports ILG 1, 11; PLO 5, 6, 7]

**Course-specific Institutional Learning Goals (ILG):**

**Institutional Learning Goal 1. Written and Oral Communication in English.** Students will communicate effectively in both speech and writing.
**Institutional Learning Goal 2. Mathematics.** Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
**Institutional Learning Goal 4. Technology.** Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

**Institutional Learning Goal 11. Critical Thinking:** Students will use critical thinking skills understand, analyze, or apply information or solve problems.

## Program Learning Outcomes for Engineering Science (PLO)

1. Analyze engineering drawings, demonstrating an understanding of the concept of scale and orthographic projection;
2. Complete written engineering reports;
3. Write computer programs to solve engineering-based problems;
4. Complete computer-aided design (CAD) drawings;
5. Communicate effectively both verbally and in writing;
6. Demonstrate effective mathematical skills and application of scientific principles in solving engineering problems;
7. Apply critical thinking and problem-solving skills in the analysis of data, design of experimental procedures, and evaluation of outcomes;

## Units of study in detail – Unit Student Learning Outcomes:

### Unit I Simple Stresses and Strain [Supports Course SLO #1, 2, 3, 4, 5, 6, 7]

***Learning Objectives***
***The student will be able to:***

- Define stress, tension, compression and shear.
- Calculate stresses in members with holes, slots, pins, or irregularities.
- Calculate the strain for a member subjected to a load in tension, compression, or shear.
- Calculate stress and strain using the Modulus of Elasticity.
- Determine the Modulus of Elasticity for a given material when subject to a tensile, compressive, or shearing load.
- Calculate working stress, factor of safety and ultimate strength.
- Complete laboratory testing and reports for various materials such as: cast iron, steel, brass, aluminum, and wood to determine their physical properties.
- Complete team assignments involving computation of stress and strain.

### Unit II Stress in Beams [Supports Course SLO #1, 2, 3, 4, 5, 6, 7]

***Learning Objectives***
***The student will be able to:***

- Draw a free body diagram showing and calculate the beam reactions.
- Calculate the shear force in a beam subjected to transverse loads.
- Compute and draw the beam's shear force diagram.
- Calculate the bending moment in a beam subjected to transverse loads.
- Compute and draw the beam's bending moment diagram.
- Compute the location of the beam's neutral axis.
- Compute the Moment of Inertia and Section Modulus.
- Compute the maximum shear and bending stresses in the beam.
- Interpret standard designations for I-beam, channels, and angles.

**Unit III** **Compression Members [Supports Course SLO #1, 2, 3, 4, 5, 6, 7]**

***Learning Objectives***
***The student will be able to:***

- Calculate the least moment of inertia with respect to the centroidal axes.
- Calculate the radius of gyration.
- Calculate the slenderness ratio from the radius of gyration.
- Use the Euler Formula to determine the buckling load for non-slender compression members.

**Unit IV** **Combined Stresses [Supports Course SLO #1, 2, 3, 4, 5, 6, 7]**

***Learning Objectives***
***The student will be able to:***

- Calculate the maximum tensile and compressive bending stresses for members subjected to bending and axial loads.

**Unit V** **Shafts Subjected to Torsion [Supports Course SLO #1, 2, 3, 4, 5, 6, 7]**

***Learning Objectives***
***The student will be able to:***

- Calculate the reactions for shafts subjected to loading in two perpendicular planes parallel to the axis of the shaft.
- Calculate the torque at different positions throughout the length of a shaft subjected to various torsional loading configurations.
- Calculate either the maximum permissible torque or maximum torsional shearing stress for both solid and hollow circular shafts when given the shaft size and applied loads.
- Select the proper diameter for solid circular shafts when given the applied loads and working stress.
- Calculate the angle of twist for a shaft or given material and dimensions and applied load.

**Evaluation of student learning:**

Course student learning outcomes will be assessed by the following activities:

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|---|---|
| Tests (3) | 30% |
| Quizzes and Homework | 20% |
| Lab Reports | 20% |
| Final Exam | 30% |