CIV230  Mechanics of Solids  4

Hours:  lecture/Lab/Other  3/3/0

Pre-requisites: MAT151 and CIV103. Both with a minimum C grade

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.

Is course New, Revised, or Modified?
New

Required texts/other materials:
Text:  Statics and Mechanics of Materials
Authors: Ferdinand P. Beer, E. Russell Johnston, John T. DeWolf, David F. Mazurek
McGraw Hill, 2011

Latest Reviewed date:  Spring 2019
Course coordinator:  James Maccariella, 609-570-3462, maccarij@mccc.edu

Information resources:
The required textbook will be used as the primary resource for this course.

Other learning resources:
There is a sophomore engineering student tutor on the West Windsor campus. The library will have reserve copies of the textbook.
Course Competencies/Goals:

The student will be able to:
1. Demonstrate basic engineering materials terminology.
2. Demonstrate the relationship between external forces member reactions.
3. Analyze various types of materials problems.
4. Generate and interpret loading diagrams.
5. Solve problems in a well-organized and logical manner.
6. Complete laboratory testing of various materials to determine their physical properties.
7. Demonstrate the relationship of engineering materials to the study of advanced topics in engineering.

Course-specific General Education Knowledge Goals and Core Skills.

General Education Knowledge Goals
Goal 1. Communication. Students will communicate effectively in both speech and writing.
Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

MCCC Core Skills
Goal A. Written and Oral Communication in English. Students will communicate effectively in speech and writing, and demonstrate proficiency in reading.
Goal B. Critical Thinking and Problem-solving. Students will use critical thinking and problem solving skills in analyzing information.
Goal F. Collaboration and Cooperation. Students will develop the interpersonal skills required for effective performance in group situations.

Units of study in detail.

UNIT I: SIMPLE STRESSES AND STRAIN

Learning Objectives

The student will be able to:

- Define stress, tension, compression and shear. (Course Competency 1; Gen Ed Goal 1; Core Skill A).
- Calculate stresses in members with holes, slots, pins, or irregularities. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- Calculate the strain for a member subjected to a load in tension, compression, or shear. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- Calculate stress and strain using the Modulus of Elasticity. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- Determine the Modulus of Elasticity for a given material when subject to a tensile, compressive, or shearing load. (Course Competencies 1, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- Calculate working stress, factor of safety and ultimate strength. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- Complete laboratory testing and reports for various materials such as: cast iron, steel, brass, aluminum, and wood to determine their physical properties. (Course Competencies 1, 3, 5, 6, & 7; Gen Ed Goals 1, 2 & 3; Core Skills A & B).
• Complete team assignments involving computation of stress and strain.  *(Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 1, 2 & 3; Core Skills A, B & C).*

UNIT II:  STRESS IN BEAMS

Learning Objectives

The student will be able to:

• Draw a free body diagram showing and calculate the beam reactions. *(Course Competencies 1, 2, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Calculate the shear force in a beam subjected to transverse loads. *(Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Compute and draw the beam's shear force diagram. *(Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Calculate the bending moment in a beam subjected to transverse loads. *(Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Compute and draw the beam's bending moment diagram. *(Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Compute the location of the beam’s neutral axis. *(Course Competencies 1, 3, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Compute the Moment of Inertia and Section Modulus. *(Course Competencies 1, 3, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Compute the maximum shear and bending stresses in the beam. *(Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Interpret standard designations for I-beam, channels, and angles. *(Course Competencies 1, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

UNIT III:  COMPRESSION MEMBERS

Learning Objectives

The student will be able to:

• Calculate the least moment of inertia with respect to the centroidal axes. *(Course Competencies 1, 3, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Calculate the radius of gyration. *(Course Competencies 1, 3, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Calculate the slenderness ratio from the radius of gyration. *(Course Competencies 1, 3, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*

• Use the Euler Formula to determine the buckling load for non-slender compression members. *(Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).*
UNIT IV: COMBINED STRESSES

Learning Objectives
The student will be able to:

- Calculate the maximum tensile and compressive bending stresses for members subjected to bending and axial loads. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).

UNIT V: SHAFTS SUBJECTED TO TORSION

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. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- Calculate the torque at different positions throughout the length of a shaft subjected to various torsional loading configurations. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- 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. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- Select the proper diameter for solid circular shafts when given the applied loads and working stress. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).
- Calculate the angle of twist for a shaft or given material and dimensions and applied load. (Course Competencies 1, 2, 3, 4, 5 & 7; Gen Ed Goals 2 & 3; Core Skill B).

Evaluation of student learning:

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<thead>
<tr>
<th>Evaluation</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>3 Tests</td>
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<tr>
<td>Quizzes</td>
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<tr>
<td>Final Exam</td>
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Academic Integrity Statement:

Students are expected to comply with the college-wide requirements for academic integrity. Mercer County Community College is committed to Academic Integrity—the honest, fair, and continuing pursuit of knowledge, free from fraud or deception. This implies that students are expected to be responsible for their own work. Presenting another individual’s work as one’s own and receiving excessive help from another individual will qualify as a violation of Academic Integrity. The entire policy on Academic Integrity is located in the Student handbook and is found on the college website (http://www.mccc.edu/admissions_policies_integrity.shtml).

Mercer County Community College is committed to ensuring the full participation of all students in all activities, programs, and services. Please refer to the Student Handbook to review accommodations available for Students with Special Needs.