Montgomery County Community College
EGR 213
Mechanics of Materials
3-2-2

COURSE DESCRIPTION:
This course covers the deformation of beams and shafts using energy methods and structural analysis, the analysis of stress and strain, stress-strain relations, shear and moment diagrams, stress and strain transformations, failure criteria and elementary plasticity. This course is subject to a course fee. Refer to http://mc3.edu/adm-fin-aid/paying/tuition/course-fees for current rates.

REQUISITES:
Previous Course Requirements
- EGR 203 Engineering Statics
- MAT 201 Calculus and Analytic Geometry II

Concurrent Course Requirements
None

LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1. Apply the principles of statics to determine internal resultant loadings in a body and to describe normal and shear stress and the design of members subjected to an axial load or direct shear.	Lecture Problem Solving Assignments Design of Experiments	Section Examination Design of Experiments Review
2. Describe the deformation of a body using the concept of normal and shear strain, including defining these quantities can be determined for various types of engineering problems.	Lecture Problem-Solving Assignments Design of Experiments	Section Examination Design of Experiments Review

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
3. Explain how stress can be related to strain using methods to determine the stress-strain diagram for a specific material and how the same are used in engineering.	Lecture Problem-Solving Assignments Design of Experiments	Section Examination Design of Experiments Review
4. Determine deformation of structural members and find the support reactions when reactions cannot be determined explicitly from the equations of equilibrium. Include the effects of thermal stress, stress concentrations, inelastic deformations and residual stress.	Lecture Problem-Solving Assignments Design of Experiments	Section Examination Design of Experiments Review
5. Examine the effects of torsional loading to a long straight member, such as a tube or shaft, and determine the stress distribution within the member, the twist angle when the material is either linearly elastic or inelastic, and the location(s) of stress concentrations and residual stress caused by torsional loading.	Lecture Problem-Solving Assignments Design of Experiments	Section Examination Design of Experiments Review
6. Design shear and moment diagrams for a beam or shafts subjected to bending and identify where and how large the greatest shear and moment occur in a bent member.	Lecture Problem-Solving Assignments Design of Experiments	Section Examination Design of Experiments Review

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
7. Apply the method for finding the shear stress in a beam having a prismatic cross section, made from a homogenous material, and behaving linearly-elastic.	Lecture Problem-Solving Assignments Design of Experiments	Section Examination Design of Experiments Review
8. Transform stress or strain components associated with a particular coordinate system into components having a different orientation.	Lecture Problem-Solving Assignments Design of Experiments	Section Examination Design of Experiments Review

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria*.

SEQUENCE OF TOPICS:

1. Introduction: Concept of Stress
- a. Review of the Methods of Statics
- b. Stresses in the Members of a Structure
- c. Stress on an Oblique Plane under Axial Loading
- d. Stress under General Loading Conditions; Components of Stress
- e. Design Considerations

2. Stress and Strain: Axial Loading
- a. An Introduction to Stress and Strain
- b. Statically Indeterminate Problems
- c. Problems Involving Temperature Changes
- d. Poisson's Ratio
- e. Multiaxial Loading: Generalized Hooke's Law
- f. Shearing Strain
- g. Deformations Under Axial Loading: Relations between E, v, and G
- h. Stress and Strain Distribution Under Axial Loading: Saint-Venant's Principle
- i. Stress Concentrations
- j. Plastic Deformations

3. Torsion
- a. Circular Shafts in Torsion
- b. Angle of Twist in the Elastic Range
- c. Statically Indeterminate Shafts
- d. Design of Transmission Shafts

   e. Stress Concentrations in Circular Shafts
4. Pure Bending
   a. Symmetric Members in Pure Bending
   b. Stresses and Deformations in the Elastic Range
   c. Deformations in a Transverse Cross Section
   d. Members Made of Composite Materials
   e. Stress Concentrations
   f. Eccentric Axial Loading in a Plane of Symmetry
   g. Unsymmetrical Bending Analysis
   h. General Case of Eccentric Axial Loading Analysis
5. Analysis and Design Beams for Bending
   a. Shear and Bending-Moment Diagrams
   b. Relationships Between Load, Shear, and Bending Moment
   c. Design of Prismatic Beams for Bending
6. Shearing Stresses in Beams and Thin-Walled Members
   a. Horizontal Shearing Stress in Beams
   b. Longitudinal Shear on a Beam Element of Arbitrary Shape
   c. Shearing Stresses in Thin-Walled Members
7. Transformations of Stress and Strain
   a. Transformation of Plane Stress
   b. Mohr's Circle for Plane Stress
   c. General State of Stress
   d. Three-Dimensional Analysis of Stress
   e. Stresses in Thin-Walled Pressure Vessels
8. Principal Stresses under a Given Loading
   a. Principal Stresses in a Beam
   b. Design of Transmission Shafts
   c. Stresses under Combined Loads
9. Deflection of Beams
   a. Deformation Under Transverse Loading
   b. Statically Indeterminate Beams
   c. Method of Superposition

LEARNING MATERIALS:
Present selected text:
Beer, F.P., Johnston, E.R. Jr., DeWolf, J.T., Mazurek, D.F. (2010). *Mechanics of Materials* (6th Ed.). McGraw-Hill.

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

COURSE APPROVAL:

Prepared by: Dr. David Brookstein, Dean for STEM Date: 3/9/2013

VPAA/Provost or designee Compliance Verification:

Victoria L. Bastecki-Perez, Ed.D. Date: 4/16/2013

Revised by: Chengyang Wang, Ph.D. Date: 12/21/2017

VPAA/Provost or designee Compliance Verification: Date: 1/10/2018

This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.