MASTER COURSE OUTLINE
Prepared By: James Sauceda Date: Sep 2017

COURSE TITLE
Mechanics of Materials

GENERAL COURSE INFORMATION

Dept.: ENGR&	Course Num: 225	(Formerly: EGR 214)
CIP Code: 14.1901	Intent Code: 11	Program Code:
Credits: 5		
Total Contact Hrs Per Qtr.: 55		
Lecture Hrs: 55	Lab Hrs: 0	Other Hrs: 0
Distribution Designation: Natural Science NS		

COURSE DESCRIPTION (as it will appear in the catalog)
An introduction to the concepts of stress, strain, deformation, and failure theory in solid materials. Applies mechanics of materials concepts to structural and machine elements such as rods, shafts, and beams. These elements are analyzed in tension, compression, bending, torsion, and shear.

PREREQUISITES
ENGR& 214, MATH& 152 with grades of 2.0 or higher

TEXTBOOK GUIDELINES
A college-level textbook such as *Mechanics of Materials* by Hibbeler, or the same title by Beer, Johnston, and DeWolf.

COURSE LEARNING OUTCOMES
Upon successful completion of the course, students should be able to demonstrate the following knowledge or skills:

1. Apply the concepts of normal and generalized shear stress to members in compression/tension, torsional and shear situations.
2. Draw a stress versus strain diagram for a specimen in tension, and discuss the elastic versus plastic region, yielding, strain hardening, necking, ultimate stress, fracture stress and true versus engineering diagrams.
3. Describe the relationship between stress and strain using Hooke's Law and Poisson's ratio for 3-dimensional problems.
4. Determine the deformation of axially loaded members, and calculate support reactions for statically indeterminate problems.
5. Calculate thermal stress and inelastic deformations and determine stress concentration factors.
6. Calculate shear stress caused by torsion, and calculate support reactions for statically indeterminate torque-loaded members.
7. Calculate normal and shear stresses in a cross-section of a symmetrical beam. This includes shear and bending moment diagrams, finding centroids, moments of inertia and the section modulus and applying the flexure and shear formulas.

8. Draw Mohr's circle and use it to determine principal stresses and maximum shear stresses and the orientation at which these stresses will occur.
9. Describe ductile and brittle behavior of materials and the failure theory of these materials.
10. Use effective techniques to define problems, gather information, analyze data, perform critical evaluations, implement solutions and communicate the results.
11. Use appropriate mathematical, sketching and modeling skills to describe concepts and systems.

INSTITUTIONAL OUTCOMES

IO2 Quantitative Reasoning: Students will be able to reason mathematically.

COURSE CONTENT OUTLINE

I. Introduction to Stress
- A. Equilibrium of Deformable Bodies
- B. Stress
  - 1. Axial Loaded Bars
  - 2. Average Shear Stress
  - 3. Allowable Stress
  - 4. Limit State Design

II. Introduction to Strain
- A. Deformation
- B. Strain
  - 1. Normal Strain
  - 2. Shear Strain

III. Mechanical Properties of Materials
- A. Tension and Compression Tests
- B. Stress-Strain Diagrams
- C. Stress-Strain Behavior of Ductile and Brittle Materials
- D. Hooke’s Law
- E. Strain Energy
- F. Poisson’s Ratio
- G. Shear Stress-Strain Diagrams

IV. Axial Load
- A. Saint-Venant’s Principle
- B. Elastic Deformation
- C. Superposition
- D. Statically Indeterminate Axial Loading
- E. Force Method of Analysis
- F. Thermal Stress
- G. Stress Concentration

V. Torsion
- A. Torsional Deformation
- B. Elastic Deformation
- C. The Torsion Formula
  - 1. Solid Shafts
  - 2. Tubular Shafts
- D. Power Transmission
- E. Angle of Twist
- F. Statically Indeterminate Torque-Loaded Members
- G. Stress Concentration

VI. Bending
    A. Shear and Moment Diagrams
    B. Bending Deformation of a Straight Member
    C. The Flexure Formula
    D. Unsymmetric Bending
    E. Stress Concentration
VII. Transverse Shear
    A. The Shear Formula
    B. Shear Flow
        1. Built-Up Members
        2. Thin-Walled Members
VIII. Combined Loadings
    A. Thin-Walled Vessels
    B. State of Stress
IX. More With Stress
    A. Equations for Plane-Stress Transformation
    B. Principal Stresses and Maximum In-Plane Shear Stress
    C. Mohr's Circle
    D. Absolute Maximum Shear Stress
X. Strain Transformation
    A. General Equations of Plane-Strain Transformation
    B. Mohr's Circle for Plane Strain
    C. Absolute Maximum Shear Strain
    D. Strain Rosettes
    E. Material Property Relationships
XI. Design of Beams
    A. Basis for Design
    B. Prismatic Beams
XII. Deflection of Beams and Shafts
    A. The Elastic Curve and the Moment-Curvature Relationship
    B. Slope and Displacement by Integration
XIII. Buckling of Columns
    A. Critical Load
    B. Column Support Types

DEPARTMENTAL GUIDELINES *(optional)*
PO5 should be assessed: Students will be able to solve problems by gathering, interpreting, combining and/or applying information from multiple sources.

_____ _____
DIVISION CHAIR APPROVAL **DATE**