**ATLANTIC CAPE COMMUNITY COLLEGE**

**COURSE TITLE**

**AERG 202-Solid Mechanics**

**COURSE DESCRIPTION**

Introduces students to the concepts of stress and strain and their tensor properties topics include but are not limited to elastic stress strain relations, analysis of stress and deformation in members subject to axial, torsional, bending and combined loading and column stability.

*Prerequisite: AERG201 with a grade of C or better*

*Credits: 3*

**TEXTBOOK**

Beer,P.F., et al. (2012). Mechanics of Materials 6th e.

McGraw Hill New York, New York

ISBN:9780073380285

**INTENDED LEARNING OUTCOMES**

Upon completion of this course students will be able to:

* Utilize critical thinking and problem solving techniques to solve Solid Mechanics problems
* Explain the impacts of stress on solids
* Explain the impacts of strain on solids
* Explain the impacts of deformations on solids

**LEARNING GOALS/OBJECTIVES**

1. **Students will study the stresses occurring in many of the elements contained in machines such as two-force members, axels, bolts and pins.**
   1. Explain stresses in the members of a structure
   2. Explain the importance of analysis and design
   3. Find normal stress in a member under axial loading
   4. Define shearing stress
   5. Explain the application of stress to the analysis and design of a simple structure
   6. Explain the importance of numerical accuracy
   7. Explain the stress on an oblique plane under axial loading
   8. Identify the components of stress under general loading conditions
   9. Identify design considerations related to stress
2. **Students will study the deformations occurring in structural components subjected to axial loading.**
   1. Define normal strain under normal loading
   2. Interpret a stress strain diagram
   3. Define true stress and true strain
   4. Explain Hooke’s law
   5. Define dilation and bulk modules
   6. Define stress concentrations
   7. Define plastic deformations
   8. Define Poisson’s ratio
   9. Define residual stress
3. **Students will learn about torsion and the stresses and deformations it causes.**
   1. Identify the stresses on a shaft
   2. Identify deformations in a circular shaft
   3. Identify stresses in the elastic range
   4. Define angle of twist in the elastic range
   5. Define statically indeterminate shafts
   6. Explain how transmission shafts are designed
   7. Identify stress concentrations in circular shafts
   8. Identify plastic deformations in circular shafts
   9. Explain torsion of noncircular members
4. **Students will learn about the normal stresses and the curvature resulting from pure bending.**
   1. Define pure bending
   2. Identify deformations in a symmetric member in pure bending
   3. Identify deformations in a transverse cross section
   4. Determine bending of members made of several materials
   5. Explain stresses and deformations in the elastic range
   6. Define stress concentrations
   7. Explain the effects of plastic deformations of members with a single plane of symmetry
   8. Identify members made of elastoplastic material
   9. Define residual stresses
   10. Define unsymmetric bending
   11. Identify the general cases of eccentric axial loading
   12. Determine bending of curved members
5. **Students will analyze and design beams for bending.**
   1. Analyze shear and bending-moment diagrams
   2. Describe the relationship among load, shear and bending moment
   3. Analyze the design of prismatic beams for bending
   4. Use singularity functions to determine shear and bending moment in a beam
   5. Define nonprismatic beams
6. **Students will study shearing stresses in beams and thin-walled members.**
   1. Explain the impact of shear on the horizontal face of a beam element
   2. Determine shearing stress in a beam
   3. Identify shearing stresses in common types of beams
   4. Discuss the distribution of stresses in a narrow rectangular beam
   5. Calculate longitudinal shear on a beam element of arbitrary shape
   6. Examine the impact of shearing stresses in thin-walled members
   7. Define thin-walled member
   8. Define unsymmetric loading
   9. Define shear center
7. **Students will learn about the transformations of stresses and strains.**
   1. Define plane stress
   2. Define maximum shearing stress
   3. Explain Mohr’s circle for plane stress
   4. Explain the general state of stress
   5. Apply Mohr’s Circle to the three-dimensional analysis of stress
   6. Yield criteria for ductile materials under plane stress
   7. Identify fracture criteria for brittle materials under plane stress
   8. Examine stresses in thin-walled pressure vessels
   9. Analyze transformation of plane stress
   10. Explain Mohr’s circle for plane stress
   11. Explain the three-dimensional analysis of strain
   12. Measure strain and strain rosette
8. **Students will determine the principal stresses in a structural members and machine elements under given loading conditions.**
   1. Identify the principal stresses in a beam
   2. Design of a transmission shafts
   3. Determine stresses under combined conditions
9. **Students will learn about strength considerations and deflection evaluations when designing beams.**
   1. Analyze deformation of a beam under transverse loading
   2. Derive the equation of the elastic curve
   3. Determine the elastic curve using load distribution
   4. Define statically indeterminate beams
   5. Define superposition
   6. Determine slope and deflection of a beam using singularity functions
   7. Apply superposition method to statically indeterminate beams
   8. Identify parts of a bending-moment diagram
   9. State moment-area theorems
   10. Applications to cantilever beams and beams with symmetric loadings
   11. Find maximum deflection
   12. Utilize moment-area theorems with statically indeterminate
10. **Students will learn about the analysis and design of columns supporting axial compression loads.**
    1. Analyze stability of structures
    2. Utilize Euler’s formula to columns with other end conditions
    3. Define other end conditions
    4. Utilize the secant formula
    5. Design of columns under centric and eccentric loads
11. **Students will learn Energy Methods.**
    1. Define strain energy
    2. Define elastic strain energy
    3. Determine elastic strain energy for normal stresses
    4. Determine elastic strain energy for shearing stresses
    5. Determine strain energy for a general stress state
    6. Define impact loading
    7. Design for impact loads
    8. Define work-energy method
    9. Find deflection under a single load by work-energy method
    10. Derive Castigliano’s theorems
    11. Utilize Castigliano’s theorem for deflections

**COURSE EVALUATION**

Examinations (3) 300 points

Homework (15) 300 points

Quizzes (15) 300 points

Final Project (1) 100 points

A= 900-1000

B=800-899

C=700-799

D=600-699

F=599-

**LEARNING ACTIVITIES**

*Examinations*

The examinations will be based on the required reading and lecture notes

*Homework*

The homework assignments will come from the end of chapter assignments in the book

*Quizzes*

Quizzes will be given at the start of each class and will be based on the assigned reading

*Final Project*

Final projects consist of group work and result in a demonstration of key course concepts