COURSE OUTLINE

CIV229 — Course Number

Mechanics of Materials — Course Title

4 — Credits

3/3 — Lecture/Laboratory Hours

COURSE DESCRIPTION

With an introduction to engineering materials and their mechanical properties, examines 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 to demonstrate various testing techniques. Fall Offering.

Text (s): **Statics & Strength of Materials**
Author: Cheng, Fa-Hwa
Publisher: McGraw Hill/Glencoe
2nd Edition, 1997
ISBN#: 0-02-803067-2

Prerequisites: **CIV106 with a minimum C grade**

Co-requisites:

Course Coordinator: Jim Maccariella **Latest Review: 2009**

I. GENERAL OBJECTIVES

A. To provide the student with an understanding of the relationship between external forces applied to an engineering structure and the resulting action of the members of the structure.

B. To understand that mechanics of materials is the basis of engineering design but it is not itself a course in design.

C. To utilize the student's background in mathematics, physics, statics, and engineering drawing so that he may solve various mechanics of materials problems in a simple, logical manner.

D. To stimulate the student's interest to investigate the many well-written texts on this subject.

II. SPECIFIC OBJECTIVES

WEEKS 1, 2, 3 – Simple Stresses and Strain

The student should be able to:

A. Define "stress" in a brief sentence, and write the defining equation and the correct units.

B. Define tension, compression, and shear and either sketch one example of each or be able to identify which of the conditions exist for a given loading configuration.

C. Write a brief explanation of the limitations placed upon the use of the equations $\sigma = P/A$ with regard to relationship of direction of the applied load, to the cross-sectional area, and also regarding the location of the load on the cross sectional area.

D. Locate and calculate the area subjected to stress at any designated cross section (or) given a member with holes, slots, pins, or any other irregularities in its cross section one must be able to calculate the stress at various points in the object and thereby locate the weakest cross section.

E. Calculate the strain when given the original length and deformation or vice versa for a member subjected to a load in tension, compression, or shear.

F. Calculate either the stress (σ) or strain (ε) using the defining relationship $\sigma = E\,\varepsilon$.

G. Determine the Modulus of Elasticity (E) for a given material when subject to a tensile, compressive, or shearing load.

H. Calculate any of the following when given adequate initial information: area (A), load (P), deformation (δ), and initial length (L).

I. Calculate "working stress", "Factor of Safety" or ultimate strength when given any two of the three items.

J. Determine the missing dimension of either circular or rectangular cross sectional areas using the relationship $\sigma = F/A$ for a member subjected to a known load and given a working stress.

WEEKS 4, 5, 6, 7, 8, 9 – Stress in Beams

The student should be able to:

A. Draw the free body diagram showing all forces, reactions, and calculate the unknown reactions for simply supported overhanging and cantilever beams.

B. Calculate the shearing force at any section of the beam subjected to both concentrated and/or uniformly distributed loads.

C. Determine the correct sign (plus or minus) for the shearing force.

D. Draw the shear diagram for any of the loading modes mentioned above (proportional but not to scale).

E. Locate the shear diagram in the proper relationship to the free body diagram of the beam.

F. Label and calculate the bending movement at any section in the beam and apply the accepted sign convention to the magnitude of the moment for the types of loading mentioned above.

G. Draw the bending moment diagram for a simply supported or cantilever beam subjected to concentrated and/or uniformly distributed loads.

H. Locate the points of zero shears on the shear diagram by inspection.

I. Locate and calculate the maximum bending moment.

J. Properly choose the maximum bending moment on the absolute value of the moments calculated.

K. Locate the neutral axis and the greatest distance to the outer fibers for a given cross section.

L. Calculate the stress and/or maximum stress due to bending moment substituting with correct units into the "Flexure Formula" $\sigma = Mc/I$.

M. Calculate the section modulus either by knowing the maximum bending moment and working stress or by calculating them from a given simply supported beam with a known working stress.

N. Calculate the diameter of a circular beam after calculating the section modulus given the information cited above.

O. Determine the dimensions of a rectangular beam when given either one dimension or using the assumption that $b = h/2$ if no dimensions are given.

P. Write and interpret the standard designations for I-beams, channels and angles of equal or unequal length legs.

Q. Select the correct structural member of a specified type, when the section modulus, maximum bending moments, and working stress are calculated.

R. Calculate the shearing stress in multiple beam types.

S. Interpret the data in a free body diagram for input into a computer program.

T. Perform the necessary steps in getting proper output from the computer, using a computer program.

U. Interpret all data found in the above output, for any problem, acceptable to the program, relating to the beam data, calculated forces, reactions, and shear/moment values and diagrams.

WEEKS 10 & 11 – Compression Members

The student should be able to:

A. Calculate and substitute the least moment of inertia with respect to the centroidal axes into the equation for the radius of gyration when given a dimensioned cross-sectional area.

B. Calculate the radius of gyration.

C. Calculate the slenderness ratio from the radius of gyration and given length in the appropriate units.

D. The student should also develop a feel for calculating the least moment of inertia by visual inspection of the shape of the cross section at the outset of the process of determining the radius of gyration to reduce the number of calculations required.

E. Use the Euler Formula to obtain the buckling load, i.e., short compression member in which crushing controls or long compression members in which buckling controls.

WEEKS 12 & 13 – Combined Stresses

The student should be able to:

A. Calculate the maximum tensile and compressive bending stresses (for short members) subjected to bending and axial loads. Members will include rectangular and circular sections, and structural steel shapes.

Weeks 13 & 14 – Shafts Subjected to Torsion

The student should be able to:

A. Calculate the reactions for shafts subjected to loading in two perpendicular planes parallel to the axis of the shaft.

B. Determine the torque at different positions throughout the length of a shaft subjected to various torsional loading configurations.

C. 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.

D. Select the proper diameter solid circular shaft when given the applied loads and working stress.

E. Calculate the angle of twist for a shaft or given material and dimensions and applied load.

Week 15

Review of Semester Work & Examination

III. METHOD OF PRESENTATION

A lecture/discussion approach is used and transparencies taken from the course text are used as well as printed handouts made by the instructor. Class participation is emphasized by asking the students questions on their reading assignments, homework problems, or actual field experience. Transparencies will also be used to review test problems.

IV. EVALUATION

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)

V. GRADING SYSTEM

3 Tests	30%
Quizzes	10%
Laboratory	20%
Computer Analysis-Homework, Class Participation	10%
FINAL EXAM	30%

VI. REFERENCES

1. Strength of Materials — Olsen – Prentice Hall
2. Mechanics of Materials — Levinson – Prentice Hall
3. Applied Strength of Materials — Jenson – McGraw Hill
4. Strength of Materials — Singer – McGraw Hill
5. Mechanics of Materials — Popov – Prentice Hall
6. Strength of Materials — Eckardt – Holt, Rinehard, Winsto
7. Metals Handbook, Vol. I, 8th. Ed. — American Society Metals