SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title:	STRENGTH OF MATERIALS
Code No.:	MCH 202
Program:	MECHANICAL TECHNOLOGY
Semester:	THREE
Date:	JUNE 1987
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New: Revision: X

APPROVED:  £** Date

CALENDAR DESCRIPTION

STRENGTH OF MATERIALS	MCH 202-4
Course Name	Course Number

PHILOSOPHY GOALS;

This course will enable the student to design beams, shafts, and columns in accordance with standard industrial practice: the knowledge acquired from this course is mandatory for employment in the engineering field.

METHOD OF ASSESSMENT (GRADING METHOD):

This course will cover Chapters 3, 4, 5, 6, and 9 in the text Mechanics of Materials by Levinson.

You will be tested on Chapters 3 and 4 two weeks after completion of these chapters.

You will be tested on Chapter 5 two weeks after completion of this chapter.

You will be tested on the remainder at the end of the course.

The marking system will be A, B, C, and I and tests will be graded on logical solution, layout, sketches and neatness.

It is expected that the student will be a punctual, regular and diligent attender in class.

TEXTBOOK(S):

Mechanics of Materials - Levinson

REFERENCES:

Mechanics of Materials - Lawson & Cox

Strength of Materials - Fitzgerald

Mechanics of Materials - Angus & Palmer

STRENGTH OF MATERIALS

MCH 202-4

COURSE OUTLINE

TOPIC NO.	PERIODS	TOPIC INFORMATION
1	6	Review of methods of sections
2	12	Torsion
3	12	Shear force & bending moment diagrams
4	8	Horizontal shear stresses in beams
5	8	Bending stresses in beams
6	10	Beam defections
7	4	Buckling of columns

STRENGTH OF MATERIALS

MCH 202

UNIT #1 REVIEW OF METHOD OF SECTIONS AND EQUILIBRIUM

GENERAL OBJECTIVES;

The student will recall Unit #4 and Unit #5 of Applied Mechanics - MCH 110.

SPECIFIC OBJECTIVES

1. To be able to recall the three equations of equilibrium.
2. To be able to apply the three equations of equilibrium.
3. To be able to calculate the internal force in a member of a structure using the Method of Sections.

UNIT #2 TORSION

GENERAL OBJECTIVE:

The student will be able to design shafts and torsion bars on the basis of shear stress and angle of twist.

SPECIFIC OBJECTIVE;

1. To be able to define the term shear stress.
2. To be able to define the term shear strain.
3. To be able to define the term polar moment of inertia.
4. To be able to calculate the polar moment of inertia for a solid circular shaft.
5. To be able to calculate the polar moment of inertia for a hollow circular shaft.
6. To be able to convert degrees to radian measure.
7. To be able to recall the number of foot pound/second in one horse power.
8. To be able to convert units of force, units of torque, units of stress, units of time and units of polar moment of inertia.
9. To be able to apply the formula using the proper units.

10. To be able to calculate the maximum shear stress.
11. To be able to calculate the maximum angle of twist.
12. To be able to construct a Twisting Moment Diagram.
13. To be able to define the term speed reducer.
14. To be able to utilize the relationship between speed and torque.
15. To be able to define the term spring constant.
16. To be able to calculate the spring constant for a solid shaft.
17. To be able to calculate the spring constant for a hollow shaft.
18. To be able to define the term series combination.
19. To be able to define the term parallel combination.
20. To be able to calculate the equivalent spring constant in a series combination.
21. To be able to calculate the equivalent spring constant in a parallel combination.
22. To be able to produce a free-body diagram for the forces on the bolts of a coupling subjected to a torque.
23. To be able to calculate the shearing stresses in the bolts of a coupling subjected to a torque.
24. The student will solve correctly the following problems: 3-2, 3, 4, 5, 6, 8, 9, 10, 13, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 44, 4 and 47.

UNIT #3 SHEAR FORCE AND BENDING MOMENT IN BEAMS

GENERAL OBJECTIVE;

The student will be able to determine the shearing force and the bending moment in any part of a statically determinate beam.

SPECIFIC OBJECTIVES:

1. To be able to define the term beam.
2. To be able to define the term statically determinate.
3. To be able to define the term shear force

To be able to define the term bending moment.

To be able to define the term simple beam.

To be able to define ther term cantilever beam.

To be able to define the term overhanging beam.

To be able to define the term concentrated load.

To be able to define the term uniformly distributed load.

To be able to define the term pure moment or couple.

To be able to recall the three equations of equilibrium.

To be able to state the convention for positive shear.

To be able to state the convention for negative shear.

To be able to state the convention for positive bending.

To be able to state the convention for negative bending.

To be able to state the relationship between the shear force diagram and the bending moment diagram.

a) To be able to ascertain the point or points of maximum shear in the shear force diagram.
b) To be able to ascertain the point or points of zero shear in the shear force diagram.

a) To be able to ascertain the point of points of maximum bending moment in the bending moment diagram.
b) To be able to ascertain the point or points of zero bending moment in the bending moment diagram.

To be able to construct the shear force diagram for a given loading on a beam.

To be able to construct the bending moment diagram for a given loading on a beam.

To be able to construct a composite bending moment diagram by the method of superposition.

a) To be able to recall the areas of a rectangle, triangle and parabola.
b) To be able to recall the position of the centroids of a rectangle, triangle and parabola.

23. The student will be able, using the above specific objectives to correctly solve the following problems: 4-4, 6, 7, 9, 11, 17, 18, 20, 24, 26, 27 and 28.

UNIT #4 HORIZONTAL SHEAR FORCE N BEAMS

GENERAL OBJECTIVE:

The student will be able to calculate the Horizontal Shear force and subsequently the Horizontal Shear Stress in order to properly design a beam.

SPECIFIC OBJECTIVES:

1. To be able to recall the convention for vertical shear.

2. To be able to construct a vertical shear force diagram.

3. To be able to recall the method of calculating the moment of the area or a homogeneous plane section.

4. To be able to state the formula for the moment of inertia of a rectangular section.

5. To be able to calculate the moment of inertia of inertia of a rectangular section.

6. To be able to state the Parallel Axis or Pappus Theorem.

7. To be able to recall the method for calculating the centroid of a homogeneous plane section.

8. To be able to calculate using the parallel axis theorem, the moment of inertia of a composite homogeneous plane section.

9. To be able to state the formula for horizontal shear stress using the proper units.

10. To be able to calculate the horizontal shear stress at any point in a composite section.

11. Given the horizontal shear stress, to be able to calculate the horizontal shear force.

12. Given the horizontal shear force, to be able to calculate the number of fasteners which may be required in a composite beam.

13. To be able to correctly solve, using the above specific objectives the following problems: 5-24, 25, 26, 27, 30, 31, 33 and 34.

UNIT #5 BENDING STRESSES IN BEAMS

GENERAL OBJECTIVE;

The student will be able to calculate the tensile and compressive stresses induced in the beam due to bending and thereby allowing the student to properly design the beam.

SPECIFIC OBJECTIVES:

1. To be able to construct a Shear Force Diagram.
2. To be able to construct a Bending Moment Diagram.
3. To be able to ascertain the points of maximum and zero bending in a Bending Moment Diagram.
4. To be able to recall the method for calculation of the moment of inertia of a composite section.
5. To be able to calculate accurately the moment of inertia of a composite section.
6. To be able to state the formula $\frac{M}{I} = \frac{}{Y}$
7. To be able to apply the formulat $\frac{M}{I} = \frac{}{Y}$ correctly using the proper units.
8. To be able to solve correctly, using the above specific objectives, the following problems: 5-5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 19.

UNIT #6 DEFLECTION OF BEAMS

GENERAL OBJECTIVE:

The student will be able, using the First and Second Moment Area Theorems, to accurately calculate the deflection at any point on a statically determinate beam.

SPECIFIC OBJECTIVES:

1. To be able to construct a Shear Force Diagram.
2. To be able to construct a Bending Moment Diagram.
3. To be able to ascertain the points of maximum and zero bending in a Bending Moment Diagram.

4. To be able to calculate accurately the moment of inertai of a composite section.

5. a) To be able to state the First Moment Area Theorem,
   b) To be able to state the Second Moment Area Theorem.

6. To be able to recall the positions of the centroids of a rectangle, triangle and parabola.

7. To be able to calculate, using the Second Moment Area Theorem, the deviation of one support point of the beam relative to the tangent drawn at the other support point.

8. To be able to calculate, using similar triangles, the vertical distance from any point on the undeflected beam to the tangent drawn from the selected support point.

9. To be able to determine the vertical deviation of any point on the deflected beam from the tangent drawn at the selected support point.

10. Using specific objectives 8 and 9, to be able to determine the vertical deflection of any point on the beam.

11. To be able to solve correctly, using the above specific objectives the following problems: 6-4, 5, 8, 11, 12, 14, 17, 20, 21, and 23.

UNIT #7 BUCKLING OF COLUMNS

GENERAL OBJECTIVES:

The student will be able to design long columns using the Euler equation and the AISC equation.

SPECIFIC OBJECTIVES:

1. To be able to define the term column.

2. To be able to construct free-body diagrams.

3. To be able to state Euler's equation.

4. To be able to determine the buckling stress.

5. to be able to determine the radius of gyration for a column.

6. To be able to define the term slenderness ratio.

7. To be able to state the range of slenderness ratios which are allowable in practice.

8. To be able to determine, from the half sine wave convention, the constants in Euler's formula for varing end conditions.

9. To be able to apply the AISC equation for permissible stress.

10. To be able to interpret the graph allowable stress/slenderness ratio for columns.

11. The student will solve correctly, using the above specific objectives, the following problems: 9-3, 4, 6, 8, 9, 10, 11, 12, 15, 20 and 22.