SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: STRENGTH OF MATERIALS

Code No.: MCH 122 - 3

Program: G.A.S. (PRE-ENGINEERING)

Semester: TWO

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Author: NORM TRIPLETT

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Chairperson Date

CALENDAR DE

STRENGTH OF MATERIALS

Course Name

SUGGESTED TEXT

Mechanics of Materials, 2nd edition
Irving J. Levinson
Prentice Hall

OTHER TEXTS FOR REFERENCE

Strength of Materials, 2nd edition
John N. Cernica
Holt, Rinehart and Winston

Resistance of Materials, 4th edition
Sealy and Smith
Wiley (Adolph's copy)

Applied Strength of Materials
Jensen

Mechanics of Materials
Popov

Introduction to Mechanics
Irving J. Levinson
Prentice-Hall

STRENGTH OF MATERIALS

TOPICS	PERIODS	TOPIC DESCRIPTION
		Laws of Equlibrium, Internal Forces and Reactions:
		method of sections - structures analysis of frames
	12	**Concept of Stress**
		general definition of stress formula and specific definition for:
		1. Normal stress (axial, tensile and compressive) 2. Bearing stress 3. Shear stress - stresses on oblique planes - vector addition-components and resultants - stress concentration and factors - working stress, and safety factor
	10	**Concept of Strain**
		strain and deformation the stress——strain curve Hooke's law Young's modulus the Equations of elasticity Poisson's Ratio
		Thermal Strain
		co-efficient of thermal expansion thermal, load deformations
		Bolted Joints/Welded Connections
		single multiple connectors design for: a) shear failure b) bearing failure c) tensile failure types of weldments

design of butt welds
design of fillet welds

NOTE: The following will be covered, if time permits:

Moment of Inertia

moment of inertia for rectangular shapes about its own neutral axis
moment of inertia for rectangular shapes about any transverse axis
moment of inertia for composite rectangular shapes
section modulus
radius of gyration

STRENGTH OF MATERIALS

GENERAL OBJECTIVES:

The general objectives are as follows:

The course provides a review of some concepts such as method of sections and free body diagrams for the determination of internal forces and reactions.

A base for subsequent strength courses is built rising concepts of stress, strain, moment of inertia.

Vertical shear and bending moment diagrams.

Work habits encouraged and developed in the first semester are reinforced with a generous number of assigned problems.

SPECIFIC OBJECTIVES:

Topic #1 - **Laws of Equilibrium, Internal Forces and Reactions**

This review work is drawn from such sources as "Introduction to Mechanics", 2nd edition, book 2, Levinson*

The student will be able to:

1. State the mathematical conditions for equilibrium.
2. Isolate members and portions of members, using free body diagrams.
3. Determine reactions, horizontal and vertical, using the laws of equilibrium and free body diagrams*
4. Determine forces in truss members by the "Method of Sections".
5. Determine pin reactions in frames.
6. Resolve forces in frame members into axial and transverse loads*

Topic #2 - **Concept of Stress**

The student will be able to:

1. Define stress in qualitative terms.
2. Explain "stress" by using an analogy to pressure.
3. State the formula for uniformly distributed axial stress, using the correct symbols.
4. State the formula for uniformly distributed shear stress, using the correct symbols.
5. State the units of stress, load and area, and prove the units of each variable by dimensional analysis.
6. State the formula or bearing stress.
7. Explain the meaning of "double stress" as it applies to the shearing action of a doubly supported pin.

Stress of Oblique Planes

8. Draw a free body diagram and relate the internal reaction at a section to the externally applied forces.
9. Resolve the internal reaction on planes other than transverse planes into components normal to, and parallel to the plane.
10. Determine the normal stress and shear stress existing in the member regardless of the inclination of the oblique plane.
11. State the angles relative to the transverse plane at which normal stress and shear stress are maximum.

Working Stress and Factor of Safety

12. Define "factor of Safety" in terms of "stress necessary to produce failure" and working stress.
13. Explain the meanings of "working stress" and/or "allowable".
14. Complete correctly, the assigned problems involving the concept of stress.

Topic #3 - **Concept of Strain**

The student will be able to:

1. Define the terms "strain and deformation" in a qualitative manner.
2. Recall the qualitative meaning of "stress".
3. Given a stress - strain curve for a typical ferrous metal or ferrous alloy, identify significant points and features.
4. Distinguish between a true S-S curve and an apparent S-S curve.
5. State Hooke's Law.
6. Define in qualitative terms, Young's Modulus, or the modulus of elasticity.
7. From the definition of Young's Modulus and from recalling the definitions of stress and strain, develop the equation for deformation.
8. Manipulate the formula for deformation, solving for any unknown quantity.
9. Explain qualitatively, the behaviour of two materials in series, deforming under axial load.
10. Explain qualitatively, the behaviour of two materials in parallel deforming under axial load.
11. Define Poisson's ratio in terms of laterial strain and axial strain.
12. Define the modulus of rigidity in terms of Poisson's ratio and the modulus of elasticity.
13. Correctly complete the assigned problems of Topic #3.

Topic #4 - **Thermal Strain**

The student will be able to:

1. Define the co-efficiental thermal expansion in terms of "strain" and change in temperature.
2. State the formula for thermal deformation in terms of the co-efficient of thermal expansion, the length of the member and the change in temperature.
3. Relate deformation due to load to deformation due to heat.

4. Explain qualitatively the behaviour of various mechanical systems under the influence of both load and temperature change.

5. Correctly complete the assigned problems of Topic #4.

Topic #5 - **Bolted and Welded Connections**

The student will be able to:

1. State the three modes of failure anticipated and designed for a bolted connection*

2. State the formula for load carrying capability of the joint based upon permissible shear stress of the bolt material and the area in shear.

3. State the formula for load carrying capability of a joint depending on the strength in bearing of the material being jointed.

4. State the formula for load carrying capability of the net area in tension in the load carrying member.

5. Explain how to calculate the load carrying capacity of a single connector joint considering the three possible failure modes.

6. Differentiate between butt and fillet welds.

7. State the formula for determining the load carrying capability of a butt weld, being aware of the special definition of "T".

8. State the formula for a load carrying capability of fillet welds,

9. Sketch the configuration and "call for" various structural shapes.

10. Using simple structural design tables, select specific dimensions and shapes properties.

11. Define efficiency of a welded joint.

12. Correctly complete the assigned problems of Topic #5.

ic **#6 - Moment of Inertia (OPTIONAL)**

student will be able to:

State the formula for the moment of inertia of a rectangular shape about its centroidal X-X and Y-Y axis.

State the formula which permits the calculation of the moment of inertia of a rectangular shape about any axis (transfer formula)*

Locate the correct value for the moment of inertia from structural tables.

Explain how the moment of inertia of a composite.

State the formula relating section modulus, moment of inertia, and the distance from the neutral axis of a beam.

Explain the meaning of neutral axis.

State the formula relating radius of gyration moment of inertia and area.

Correctly complete the assigned problems of Topic #6.