SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: STRENGTH OF MATERIALS

Code No.:

Program: G.A.S. (Pre-Enqineerinq)

Semester: TWO

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Chairperson^ Date

STRENGTH OF MATERIALS

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

STRENGHT 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 (axi al , 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 1 aw Young ' s modulus the Equations of elasticity Poi sson ' s Ratio **Thermal Strain** co-efficient of thermal expans ion thermal; load deformations **Bolted Joints** single multiple connectors des ign for: a) shear failure b) beari ng failure c) tens ile failure

TOPICS	PERIODS	TOPIC DESCRIPTION
		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

NOTE: THE FOLLOWING WILL BE COVERED, IF TIME ALLOWS

		Shear and Bending in Statically Determinant Beams
		Reactions Vertical shear force diagrams Bending moment diagrams Point of maximum bending Maximum bending moment Flexure formula

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 ;.;e first semester are reinforced with a generous number of assincod 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 for 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 corectly, the assigned problems involving the concept ofstress.

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 allay, 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 poissons 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-effeciental thermal expansion in terms of **"strain"** and change in temperature.

2. **State** the formula for thermal deformat ion in terms of **the** coefficient of thermal expansion, the lenqth of the **member** and the change in temperature.

3. **Relate** deformation due to load to deformation due to **heat**

4. **Explain** qualitatively the behavior 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 Riveted Connections

The students will be able to:

1. **State** the three nodes 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 throe possible failure modes.

Multiple Connectors

In a joint in which there are two or more lines of bolts, be able to explain:

(a) How the bolts share load

(b) How load is shared by the projected areas of the drilled holes in the load carrying member.

(c) How the load is considered to be carried across the lines of bolt holes throucrh tensile load capability of the net area of the load carrying member.

Correctly complete the assigned problems of Topic #5

Topic #6 Moment of Inertia

The student will be able to:

1. State the formula for the moment of inertia of a rectangular shape about its centroidal X-X and Y-Y axis.
2. State the formula which permits the calculation of the moment of inertia of a rectanular shape about any axis, (transfer formula)
3. Locate the correct value for the moment of inertia from structural tables.
4. Explain how the moment of inertia of a composite.
5. State the formula re?atinq section modulus, moment of inertia, and the distance from the neutral axis of a beam
6. **Explain the meaning** of neutral axis.
7. **State the** formula relating radius of gyration **moment** of inertia and area.
8. Correctly complete the assigned problems of Topic #6.

Topic #7 Shear and Bending In Statically Determinant Beams

The student will be able to:

1« Illustrate by sketches the difference between point loads uniformly distributed loads, and non uniformly distributed loads.

2. Explain the method for cnlculating and checking the reactions for simply supported and cant lever members under the influence of various loadings.

3. Recall the meanings of vertical shear force and bending moment.

4. By the use of free body diagrams of sections of a beam, explain how vertical shear forces and bending moments can be calcula ted.

5. **Draw** according to convention, the vertical shear force diagram for a loaded - supported beam.

6. Draw according to convention, the bending moment diagram **for** a loaded - supported beam.

7. Correctly comple te the assigned problems of Topi c if9.

NOTE: This topic is optional and will be introduced if time allows.