Course: MENG 273 – Strength of Materials, 2018
Instructor: Russ Rook, M.A.Sc., P.Eng.
Office: TEC 113
Email: rook@camosun.ca

Calendar Description

Using the laws of statics as a foundation, students will study topics in basic strength of materials theory including axial, direct shear, torsion, bending, and transverse shear stresses. The Bernoulli-Euler beam theory will be used to predict the deflection of beams, and shear and bending moment diagrams will be constructed. Students will learn how to combine stresses using transformation equations and Mohr's circle to determine maximum shear and principal stresses, in order to predict elastic failure. Types of failure and welded connections will also be considered. Case studies and practical design examples will be emphasized.

Only open to students in the Mechanical Engineering Technology program.

Intended Learning Outcomes

Upon successful completion of this course a student will be able to:

- Describe the mechanical properties of elastic materials, such as strength, toughness, hardness, modulus of elasticity (through Hooke's law), modulus of rigidity, and Poisson's ratio.
- Use the principles of static equilibrium and free-body diagrams to compute internal forces and moments within various structures.
- Construct shear and moment diagrams for beam geometries.
- Analyze structural systems to determine:
    - average normal stresses and deformations in bars under axial loads, and work through statically determinant and indeterminant problems
    - direct shear stresses on bolted connections
    - torsional shear stresses and angle of twist in circular sections
    - normal bending stresses using the flexure formula
    - the transverse shear stress, and understand how to properly compute the statical moment and shear flow in thin sections
- Calculate combined stresses at any location in cases of axial, bending, torsion, and transverse shear stresses, and understand the concept of the stress element.
- Explain the stress transformation equations and Mohr's circle.
- Calculate axial and hoop stresses in pressure vessels.
- Use the Bernoulli-Euler beam theory of deflection to calculate statically determined and statically indeterminate problems.
- Discuss a basic analysis of welded connections.
- Solve practical design applications based on case studies.

Required Textbook

Mechanics of Materials, 10th Ed., R.C. Hibbeler (***any*** **printed** version is acceptable)

Course Content (subject to modification, if necessary)

Week	Labs	Assignments	Course Content
1	-	-	Mechanical properties of elastic materials, load-deflection and stress-strain diagrams, Hooke's law, the laws of static equilibrium and free-body diagrams.
2	Lab 1	-	Internal forces and moments, internal loading sign convention, shear and bending moment diagrams.
3	Lab 1 Analysis	1-1,1-6,1-11, 1-17,1-23,6-1	The stress element, linear and angular stress and strain, average normal stress, axial deformation, statically indeterminant examples.
4	Lab 2	-	Direct shear stress, centroid review, second-moment of area, parallel axis theorem.
5	Lab 2 Analysis	-	Torsional shear stress, angle of twist.
6	-	1-77,1-87,2-3,5-13, 5-27,5-31,5-53	Normal bending stress, the flexure formula.
7	Lab 3	-	Transverse shear stress.
8	Lab 3 Analysis	6-49,6-63,6-71, 6-81,7-6,7-9,7-11	Shear flow in thin-walled sections, combined stresses.
9	Lab 4	-	Prediction of failure for ductile materials, **MIDTERM exam**.
10	Lab 4 Analysis	8-21,8-25,8-41	Transformations of biaxial stresses, maximum in-plane shear stresses and principal stresses, Mohr's circle.
11	-	-	Examples of combined stresses and stress transformations, including thin-walled pressure vessels.
12	Lab 5	9-15,9-23,9-25, 9-31,9-69,9-71	Beam analysis, deflections using singularity functions.
13	Lab 5 Analysis	-	Examples of beam analysis for statically indeterminant systems.
14	-	12-15,12-37, 12-43,12-105,+Weld Questions on K:	Weld analysis and consideration of bolted connections.

Lab Assignments & Evaluation

Laboratory experiments will be given throughout the semester, tentatively planned for the weeks given in the above table. Regular (non-experiment) lab sessions will typically consist of lab data analysis reviews or tutorials. Assignments will be graded based on completion, with solutions posted after the assignment is due. Assignments are due by 5:30 on the Friday of the weeks indicated in the above table, and **no late assignments will be accepted for grading**.

Labs	15%	
Assignments	15%	
Midterm Exam	30%	(open textbook only)
Final Exam	40%	(open textbook only)

→ You must pass the final exam to pass MENG 273

A+	90 - 100%	**B-**	70 - 72%
A	85 - 89%	**C+**	65 - 69%
A-	80 - 84%	**C**	60 - 64%
B+	77 - 79%	**D**	50 - 59%
B	73 - 76%	**F**	< 50%