

Course: MENG 273 – Strength of Materials, 2020
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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 indeterminate 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 (hard-copy or etextbook)

Course Content (subject to modification, if necessary)

Week	Labs	Quizzes	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	Tutorial	Quiz #1	-	Internal forces and moments, internal loading sign convention, shear and bending moment diagrams.
3	Lab 1 (Online)	Quiz #2	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 indeterminate systems.
4	Tutorial	Quiz #3	-	Direct shear stress, centroid review, second-moment of area, parallel axis theorem.
5	Lab 2 (Online)	Quiz #4	-	Torsional shear stress, angle of twist.
6	Tutorial	Quiz #5	1-77,1-87,2-3,5-13, 5-27,5-31,5-53	Normal bending stress, the flexure formula.
7	Tutorial	Quiz #6	-	Transverse shear stress.
8	Lab 3 (Online)	Quiz #7	6-49,6-63,6-71, 6-81,7-6,7-9,7-11	Shear flow in thin-walled sections, combined stresses.
9	Tutorial	Quiz #8	-	Prediction of failure for ductile materials.
10	Lab 4 (Online)	Quiz #9	8-21,8-25,8-41	Transformations of biaxial stresses, maximum in-plane shear stresses and principal stresses, Mohr's circle.
11	Tutorial	Quiz #10	-	Examples of combined stresses and stress transformations, including thin-walled pressure vessels.
12	Lab 5 (Online)	Quiz #11	9-15,9-23,9-25, 9-31,9-69,9-71	Beam analysis, deflections using singularity functions.
13	Tutorial	-	-	Examples of beam analysis for statically indeterminate systems.
14	-	Quiz #12	12-15,12-37, 12-43,12-105,+Weld Questions on D2L	Weld specification and analysis, course review (time permitting).

Lab Assignments & Evaluation

Laboratory experiments and/or tutorials will be given throughout the semester, tentatively planned for the weeks given in the above table. Tutorials will be live via Discord (<https://discordapp.com/>). 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**. Short (approx. 15 minutes) weekly quizzes will be given at the start of class during the weeks indicated. See <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf> for the Camosun grading policies.

Labs	20%
Assignments	20%
Weekly Examinations (Quizzes)	60% (5% per Quiz)

College Supports, Services & Policies

Immediate, Urgent, or Emergency Support

If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), SEEK HELP. Resource contacts can be found at <http://camosun.ca/about/mental-health/emergency.html> or <http://camosun.ca/services/sexual-violence/get-support.html#urgent>.

College Services

Camosun offers a variety of health and academic support services, including counselling, dental, disability resource centre, help centre, learning skills, sexual violence support & education, library, and writing centre. For more information on each of these services, visit the STUDENT SERVICES link on the College website at <http://camosun.ca/>.

College Policies

Camosun strives to provide clear, transparent, and easily accessible policies that exemplify the college's commitment to life-changing learning. It is the student's responsibility to become familiar with the content of College policies. Policies are available on the College website at <http://camosun.ca/about/policies/>. Education and academic policies include, but are not limited to, Academic Progress, Admission, Course Withdrawals, Standards for Awarding Credentials, Involuntary Health and Safety Leave of Absence, Prior Learning Assessment, Medical/Compassionate Withdrawal, Sexual Violence and Misconduct, Student Ancillary Fees, Student Appeals, Student Conduct, and Student Penalties and Fines.