

Course: MENG 274 – Advanced Strength of Materials, 2021
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Calendar Description

Students will receive an introduction to plasticity, beam shape factors, and residual stresses. The design of columns and struts will be discussed. The student will also determine how to analyze systems experiencing asymmetric bending, as well as the deflection of curved beams. Energy methods applied to strength of materials will be developed, including concepts of strain energy, the principle of virtual work, the principle of stationary potential energy, and Castigliano's theorems. As well, impact loading will be considered from an energy approach.

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:

- Use elastoplastic (EPP) analysis to:
 - determine the beam section shape factor
 - calculate residual stresses in sections.
- Design columns for safe working loads.
- Design sections subjected to asymmetric bending, and determine the orientation of the neutral axis.
- Calculate stresses and deflections in thin curved members.
- Formulate a definition of strain energy in terms of basic stresses, and apply the conservation of energy to analyze structures subjected to impact loading.
- Describe the application of energy principles, such as:
 - the principle of virtual work
 - the principle of stationary potential energy
 - Castigliano's first and second theorems.

Text & References

Mechanics of Materials, 10th Ed., R.C. Hibbeler

Course Content (subject to modification, if necessary)

Week	Quizzes	Labs	Assignments	Course Content
1	-	-	-	Introduction to plastic deformations, inelastic bending, elastic-perfectly-plastic (EPP) material assumptions.
2	Quiz 1	Lab 1	-	Beam shape factors, EPP analysis, residual stresses.
3	Quiz 2	-	6-158,6-163, 6-165,6-177	Columns and buckling theory, column design equations.
4	Quiz 3	Lab 2	-	Offset loading of columns, the secant formula, asymmetric bending, angle to the neutral axis.
5	Quiz 4	-	13-17,13-19,13-27, 13-55,6-105,6-113	Bending of curved beams (Winkler's theory).
6	-	-	-	READING BREAK
7	Quiz 5	-	6-137,6-139, 6-141,8-73	Curved beam analysis, introduction to energy principles.
8	Quiz 6	Lab 3	-	Catch-up, summary, and review.
9	-	-	-	External work and strain energy, stress analysis using energy principles.
10	Quiz 7	-	-	Conservation of energy for elastic materials, impact loading using energy principles.
11	Quiz 8	Lab 4	14-3,14-7,14-9, 14-27,14-44,14-52	The principle of virtual work with examples.
12	Quiz 9	-	-	The principle of stationary potential energy.
13	Quiz 10	-	14-72,14-85,14-87, +questions on D2L	Castigliano's first & second theorems.
14	Quiz 11	-	14-123,14-124, 14-128	Course catch-up & final review.

Lab, Assignment & Quiz Evaluations

Laboratory experiments will be given throughout the semester, tentatively planned for the weeks given in the above table. Due to the online nature of this course, lab experiment videos will be posted, and data typically given to the students, and subsequent data-analysis is to be performed by the student, and submitted for grading in the form of a *Lab Exercise*. *Assignments* will be graded based on completion, with solutions posted on D2L after the assignment is due. Assignments are due by 5:30 on the Friday of the weeks indicated in the above table. Almost every week (see schedule above), a timed *Quiz* will be posted to D2L based on the previous week's content. These quizzes are the primary method of evaluation, and replace traditional, in-person examinations. See <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf> for the Camosun grading policies. **All Lab Exercises, Assignments, and Quizzes will be submitted via the appropriate D2L drop-box by the due dates; no late material will be accepted for grading.**

Lab Exercises	15%	
Assignments	25%	
Quizzes	60%	(equally weighted)

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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>.

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