CARLETON UNIVERSITY
Department of Civil and Environmental Engineering

Course Outline
CIVE 5101 – Solid Mechanics Fall 2024

Time:
Place:

Instructor: Khoo, H.A. **Room 3364 ME**
Phone 520-2600 Ext. 5798 **heng.khoo@carleton.ca**
Office Hour: **To be determined**

1) Course description
Cartesion tensor notation; stresses and strains in a continuum; transformations, invariants; equations of motion; constitutive relations; generalized Hooke's Law, bounds for elastic constant: strain energy, superposition, uniqueness; formulation of plane stress and plane strain problems; energy principles, variational methods; plasticity

2) Objectives and Learning Outcomes:
Upon successful completion of this course, students will acquire general knowledge on continuum mechanics and theory of elasticity: tensors, stress, strain, Hooke's law, problems in linear elasticity, equilibrium formulations using energy, plasticity.

1. Know the properties and used of tensor in solid mechanics.
2. Learn about different definitions of stress, stress equilibrium, stress transformation, principal stresses and invariants
3. Understand the formulations of strain for small and large displacement (rotation), relative displacement and rotation, the relationship between strain and displacement (compatibility), strain transformation, principal strains and invariants
4. Learn about the relationship between stress and strain for linear elasticity (Hooke's law), various forms of linear elastic materials
5. Know displacement and stress formulations of differential equations for linear elastic problems. Understand the assumption and formulation of plane stress and plane strain problem, relationship between plane stress and plane strain, Airy stress function, and solving problems using stress function.
6. Know the formulation of equilibrium using energy; variational method, principle of virtual work, principle of complementary virtual work (force), Castigliano theorems and other theorems. Applications using various energy principles.
7. Understand plasticity for metal, kinematic and isotropic hardening, yield function, evolution of plastic strain

	Topic
1	Vectors and tensors (basic tools)
2	Stress: stress tensor, transformation, differential equations of equilibrium, principal stresses and invariants
3	Strain: strain – displacement equations, transformation, relative displacement and rotation
4	Constitutive equations for linear elasticity
5	Plane stress and plane strain problems in linear elasticity
6	Energy principles, variational methods, various equilibrium formulations using energy
7	Mathematical theory of plasticity
8	Torsion: St. Venant and warping (if time permitted)

Marking:

Assignments: 50%
Final Exam: 50%

The final exam is closed book. Formula sheet will be provided. No electronic device other than the calculator is allowed.

a) Missed Term work

Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for alternate arrangements with the instructor and in all cases this must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult Section 9.4 of the University Calendar

b) Final Examination

i) Final exam is for evaluation purpose and will not be returned to students.

ii) Students who are unable to write the final examination because of a serious illness/emergency or other circumstance beyond their control may apply for accommodation by contacting the Registrar's office. Consult Section 9.3 of the University Calendar

c) Late Submission Policy

Assignment due date is strict. Late submissions of Assignments will be given zero. 10 % deduction if Assignments handed in that are not stapled.

Notes:

1. The instructor may modify the outline during the term as the course progresses.
2. All email correspondence has to originate from the Carleton email account. I will only response to the Carleton email account.
3. Copyright: The materials (including the course outline and any slides, posted notes, videos, labs, project, assignments, quizzes, exams and solutions) created for this course and posted on this web site are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).
   The partial notes supplied on the website are intended to serve as complement and not replacement to regular class attendance. The author does not guarantee these notes to be 100% error free. Every effort will be made to identify the error and correct it during class
4. Academic Accommodation (Pregnancy obligation, Religious obligation, Academic Accommodations for Students with Disabilities, Survivors of Sexual Violence, Accommodation for Student Activities etc.)

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, see processes for academic accommodation requests (https://students.carleton.ca/course-outline/)

5. Student or professor materials created for this course (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the author(s). They are intended for personal use and may not be reproduced or redistributed without prior written consent of the author(s).
6. You may discuss with others, but you are required to submit your own work for Homework. You may not complete the submitted work collaboratively. See the institutional policy on the academic integrity (https://carleton.ca/registrar/academic-integrity/)

Some References:

1. Chou and Pagano: *Elasticity: Tensor, Dyadic and Engineering Approaches*
2. Timoshenko and Goodier: *Theory of Elasticity*
3. Fung: *Foundations of Solid Mechanics*
4. Sokolnikoff: *Mathematical Theory of Elasticity*
5. Wang: *Applied Elasticity*
6. Nadeau: *Introductory to Elasticity*
7. Jeffreys: *Cartesian Tensors*
8. Westergaard: *Theory of Elasticity and Plasticity*
9. Fung: *A First Course in Continuum Mechanics*
10. Hodge: *Continuum Mechanics*
11. Malvern: *Introduction to the Mechanics of a Continuous Medium*
12. Prager: *Introduction to Mechanics of Continua*
13. Spencer: *Continuum Mechanics*