CIVE 3202 - Mechanics of Solids II
Course Outline
(Winter 2019)

1. Instructor and Teaching Assistants
   - **Instructor:** Vahid Sadeghian, Ph.D., Assistant Professor
     Office: 2035 Minto Centre
     Email: Vahid.Sadeghian@Carleton.ca
   - **Teaching Assistants:** TBD

2. Course Schedule

<table>
<thead>
<tr>
<th>Class Type</th>
<th>Day</th>
<th>Time</th>
<th>Location</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>Tuesday &amp; Thursday</td>
<td>11:35 - 12:55</td>
<td>Azrieli Theater 301</td>
<td>A</td>
</tr>
<tr>
<td>PA and Lab¹</td>
<td>Monday</td>
<td>8:35 - 11:25</td>
<td>Mackenzie Building 3190</td>
<td>A7O/A8E</td>
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<tr>
<td></td>
<td>Monday</td>
<td>14:35 - 17:25</td>
<td>Loeb Building A204</td>
<td>A1O/A2E</td>
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<tr>
<td></td>
<td>Wednesday</td>
<td>14:35 - 17:25</td>
<td>Canal Building 2400</td>
<td>A3O/A4E</td>
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<tr>
<td></td>
<td>Friday</td>
<td>8:35 - 11:25</td>
<td>Southam Hall 314</td>
<td>A9O</td>
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<tr>
<td></td>
<td>Friday</td>
<td>14:35 - 17:25</td>
<td>Mackenzie Building 3165</td>
<td>A5O/A6E</td>
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</tbody>
</table>

¹ All laboratory sessions have the same weekly schedule but the labs are held in MC 1084.
² See Academic Support (MC 2090) if there is any conflict for this course schedule (e.g. section assignment)
3. Objectives and Learning Outcomes

Upon successful completion of this course, the student will:

✓ acquire knowledge on the fundamental principles, theory and application of advanced solid mechanics, for the topics outlined in the following, with respect to the analysis of common problems encountered in Civil Engineering,

✓ develop critical thinking skills, through the synthesis of engineering knowledge acquired from this course and others,

✓ apply skill in solving problems, interpreting results and understanding how these outcomes can be used to support engineering analysis and design, and

✓ acquire technical capabilities (e.g., software programming) and personal attributes (e.g. work effectively within a team environment).

4. Course Topics

1. Stress and Equilibrium Conditions
   1.1 Definition of Stress at a Point
   1.2 Stresses Due to Beam Section Forces
   1.3 Transformation of Stresses
   1.4 Principal Stresses
   1.5 Octahedral Stresses
   1.6 Mean and Deviator Stresses
   1.7 Mohr’s Circle of Stress

2. Strain and Compatibility Conditions
   2.1 Introduction
   2.2 Two-Dimensional Strain
   2.3 Principal Strains
   2.4 Strain Transformation
   2.5 Mohr’s Circle of Strains
   2.6 Strain Gage

3. Constitutive Relations
   3.1 Introduction
   3.2 Isotropic Homogeneous Materials
   3.3 Elastic Constants
   3.4 Plane Stress and Plane Strain
   3.5 Strain Energy Due to Elastic Deformations
   3.6 Orthotropic Materials
   3.7 Nonlinear and/or Inelastic Materials

4. Shear Flow and Shear Center
   4.1 Shear Stresses in Thin-Walled Open Sections
4.2 Shear Center of Thin-Walled Open Sections
4.3 Shear Stresses in Beams Bent About Non-Principal Axes

5. **Torsion**
   5.1 Torsion of a Circular Bar
   5.2 Torsion in Non-Circular Sections
   5.3 Torsion in Composite Rectangular Sections
   5.4 Torsion in Thin-Wall Tubes

6. **Failure Criteria**
   6.1 General Concepts
   6.2 Rankine Criterion
   6.3 Tresca Criterion
   6.4 Von Mises Criterion
   6.5 Mohr-Coulomb Criterion
   6.6 Drucker-Prager Criterion

7. **Energy Methods**
   7.1 Principle of Stationary Potential Energy
   7.2 Principle of Complementary Energy
   7.3 Strain Energy of Axial Load Condition
   7.4 Strain Energy of Pure Bending Condition
   7.5 Strain Energy of Shear Condition
   7.6 Strain Energy of Circular Bar in Torsion
   7.7 Application to Statically Determinate Structures
   7.8 Application to Statically Indeterminate Structures

8. **Elastic Stability**
   8.1 Introduction
   8.2 Definition of Critical Load
   8.3 Beam-Column Equations
   8.4 Column Buckling Loads
   8.5 Solution of Beam-Columns
   8.6 Initially Bent Member
   8.7 Eccentrically Loaded Columns

9. **Introduction to Finite Element Analysis**

10. **Fatigue and Fracture (time permitting)**

5. **Course Resources**

   Every week a PDF file of the course notes for the next lecture will be uploaded on the cuLearn website. Students are responsible to print the course notes and bring them to the class. It is strongly recommended that students attend the classes to develop supplementary notes based
on the technical discussions and sample problems solved during the lectures. The recommended text books for this course are:


None of the above-mentioned text books is mandatory. All of the required course materials will be provided to the students during the course.

6. Evaluation Method

<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Pre-lecture quizzes</td>
<td>5%</td>
</tr>
<tr>
<td>Lab analyses</td>
<td>5%</td>
</tr>
<tr>
<td>Assignments</td>
<td>10%</td>
</tr>
<tr>
<td>Midterm exam</td>
<td>30%</td>
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<tr>
<td>Final exam</td>
<td>50%</td>
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</tbody>
</table>

- **Pre-lecture quizzes**
  Before each lecture, students are expected to read the course notes and complete a brief pre-lecture quiz on the cuLearn website. Each quiz will be given a mark out of 2 for effort and completion. Responses to the questions should be short and do not necessarily have to be correct to receive full marks. The goal of the pre-lecture quiz is to ensure that students learn the material ahead of time and to provide the instructor with information about which concepts students had the most difficulty with. Quizzes should be completed individually.

- **Lab analyses**
  Students will conduct two laboratory exercises during this course, and are expected to complete an online laboratory analysis case for each exercise through the cuLearn website.

- **Assignments**
  At the end of each topic, an assignment will be posted on the cuLearn website. Students should use their course notes, supplementary notes taken during the lectures, and sample problems solved by the TAs and the instructor to complete assignments. Unlike the pre-lecture quizzes, responses to the assignment questions should be correct to receive full marks. Assignments should be completed individually.

- **Exams**
  The midterm and final exams have not yet been scheduled. Both exams will be closed book with one student-created aid sheet permitted.
7. Academic Regulations, Policies and Support Services

The following electronic resources provide information on academic regulations, policy and support services:

7.1 Regulations
- [http://calendar.carleton.ca/undergrad/regulations/academicregulationsandrequirementsforthebachelorofengineeringdegree/](http://calendar.carleton.ca/undergrad/regulations/academicregulationsandrequirementsforthebachelorofengineeringdegree/)
- [https://carleton.ca/cee/current-students/current-undergraduate-students/](https://carleton.ca/cee/current-students/current-undergraduate-students/)

7.2 Student Rights and Responsibilities

7.3 Academic Support Services
[https://carleton.ca/academics/support/](https://carleton.ca/academics/support/)

8. Academic Accommodation

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website ([www.carleton.ca/pmc](http://www.carleton.ca/pmc)) for the deadline to request accommodations for the formally-scheduled exam (if applicable).