

## CIVE 3202 - Mechanics of Solids II

### Course Outline

(Fall 2024)

#### 1. Instructor and Teaching Assistants

- **Instructor:** Vahid Sadeghian, PhD, PEng  
Email: [Vahid.Sadeghian@Carleton.ca](mailto:Vahid.Sadeghian@Carleton.ca)  
Office: 2035 Minto building
- **Instructor's Office hours:** TBA
- **Teaching Assistants:** TBA
- **TA Office hours:** TBA

#### 2. Course Schedule

Class Type	Group	Day	Time	Location
Lectures	A	Wednesday & Friday	4:05 pm – 5:25 pm	
PA Sessions	L1	Tuesday	11:35 am - 12:55 pm	
	L2	Friday	1:05 pm - 2:25 pm	
	L3	Monday	10:05 am - 11:25 am	

Contact Academic Support if there is any conflict for this course schedule.

### 3. Weekly Schedule (subjected to change)

Week	Lecture	PA session	TA
Week of Sept 2	Intro	NA	NA
Week of Sept 9	Chapter 1		
Week of Sept 16	Chapter 1		
Week of Sept 23	Chapter 2	Chapter 1	TBA
Week of Sept 30	Chapter 3	Chapter 2	
Week of Oct 7	Chapters 3 and 4	Chapter 3	
Week of Oct 14	Chapter 4	Review of 1 to 3	
Week of Oct 21	Fall Break		
Week of Oct 28	Chapters 4 and 5	Chapter 4	TBA
<b>Midterm exam on Saturday Nov 2 at 9 am (tentative date)</b>			
Week of Nov 4	Chapters 5 and 6	Lab session	TBA
Week of Nov 11	Chapters 6 and 7	Lab session	TBA
Week of Nov 18	Chapter 7	Chapters 4 and 5	
Week of Nov 25	Chapters 7 and 8	Chapters 5 and 6	TBA
Week of Dec 2	Chapter 8	Chapters 7 and 8	

Note: all lectures and PA sessions will be in-person.

## 4. 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., hand calculation methods and basic computer modeling) and personal attributes (e.g. work effectively within a team environment).

## 5. Course Topics (subjected to change)

### 1. Stress and Equilibrium Conditions

- 1.1 Chapter Significance
- 1.2 Learning Objectives
- 1.3 Definition of Stress at a Point
- 1.4 Stresses Due to Beam Section Forces
- 1.5 Transformation of Stresses
- 1.6 Principal Stresses
- 1.7 Octahedral Stresses
- 1.8 Mean and Deviator Stresses
- 1.9 Mohr's Circle of Stress
- 1.10 The Most Common Types of Questions

### 2. Strain and Compatibility Conditions

- 2.1 Chapter Significance
- 2.2 Learning Objectives
- 2.3 Definition of Strain
- 2.4 Two-Dimensional Strain
- 2.5 Principal Strains
- 2.6 Strain Transformation
- 2.7 Normal and Shear Strains
- 2.8 Mohr's Circle of Strains
- 2.9 Strain Gauge
- 2.10 The Most Common Types of Questions

### 3. Constitutive Relations

- 3.1 Chapter Significance
- 3.2 Learning Objectives

- 3.3 Introduction
- 3.4 Isotropic Homogeneous Materials
- 3.5 Elastic Constants
- 3.6 Plane Stress and Plane Strain
- 3.7 Strain Energy Due to Elastic Deformations
- 3.8 Orthotropic Materials
- 3.9 The Most Common Types of Questions

**4. Shear Flow and Shear Center**

- 4.1 Chapter Significance
- 4.2 Learning Objectives
- 4.3 Introduction
- 4.4 Shear Stresses in Thin-Walled Open Sections
- 4.5 Shear Center of Thin-Walled Open Sections
- 4.6 Shear Stresses in Beams Bent About Non-Principal Axes
- 4.7 The Most Common Types of Questions

**5. Torsion**

- 5.1 Chapter Significance
- 5.2 Learning Objectives
- 5.3 Torsion of a Circular Bar
- 5.4 Torsion in Non-Circular Sections
- 5.5 Torsion in Composite Rectangular Sections
- 5.6 Torsion in Thin-Wall Tubes
- 5.7 The Most Common Types of Questions

**6. Failure Criteria**

- 6.1 Chapter Significance
- 6.2 Learning Objectives
- 6.3 General Concepts
- 6.4 Rankine Criterion
- 6.5 Tresca Criterion
- 6.6 Von Mises Criterion
- 6.7 Mohr-Coulomb Criterion
- 6.8 Drucker-Prager Criterion
- 6.9 The Most Common Types of Questions

**7. Energy Methods**

- 7.1 Chapter Significance
- 7.2 Learning Objectives
- 7.3 Principle of Stationary Potential Energy
- 7.4 Principle of Complementary Energy
- 7.5 Strain Energy of Axial Load Condition
- 7.6 Strain Energy of Pure Bending Condition
- 7.7 Strain Energy of Shear Condition

- 7.8 Strain Energy of Circular Bar in Torsion
- 7.9 Application to Statically Determinate Structures
- 7.10 Dummy Load Method
- 7.11 The Most Common Types of Questions

**8. Elastic Stability**

- 8.1 Chapter Significance
- 8.2 Learning Objectives
- 8.3 Introduction
- 8.4 Definition of Critical Load
- 8.5 Beam-Column Equations
- 8.6 Column Buckling Loads
- 8.7 Solution of Beam-Columns
- 8.8 Initially Bent Member
- 8.9 Eccentrically Loaded Columns
- 8.10 The Most Common Types of Questions

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

**10. Application of Solid Mechanics to Finite Element Analysis (time permitting)**

**6. Course Resources**

Every week, a PDF file of the course notes for the next lecture will be uploaded on Brightspace. It is strongly recommended that students attend classes to develop supplementary notes based on the technical discussions and sample problems solved during the lectures. The recommended textbooks for this course are:

- **Reference 1:** Advanced Mechanics of Materials, 6<sup>th</sup> Edition; A.P. Boresi, and R.J. Schmidt; Wiley; ISBN-13: 978-0471438816
- **Reference 2:** Mechanics of Materials. 10<sup>th</sup> Edition; R.C. Hibbeler; ISBN 0-13-431965-0

**Note:** None of the above-mentioned textbooks is mandatory. All of the required course materials will be provided to the students during the course.

The following table can help to find the chapters of references that are relevant to this course.

CIVE3202 Chapters	Subject	Reference #1 Relevant Chapters	Reference #2 Relevant Chapters
1 to 3	Stress, Strain, Constitutive Relations	2 and 3	---
4 and 5	Shear and Torsion	6 and 8	5 and 7
6	Failure Criteria	4.3 to 4.5	10.7
7	Energy Methods	5	14
8	Elastic Stability	12	13

## 7. Evaluation Method

Type	Percentage
Pre-lecture quizzes	Bonus*
Lab report	5%
Assignments	15%
Midterm exam	30%
Final exam	50%

\* For every quiz that you score 80% or more, 1% bonus mark will be added to your final grade.

- **Pre-lecture quizzes**

Students are expected to read the course notes and complete a brief pre-lecture quiz on Brightspace. The goal of the pre-lecture quiz is to make students familiar with the lecture 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 (in one lab session) and are expected to complete a laboratory report for each exercise. This enables students to examine the theoretical concepts that they have learned during the class through experiments.

- **Assignments**

At the end of each topic, an assignment will be posted on Brightspace. 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. Assignments should be completed individually and **submitted on paper** at the beginning of the class. **There will be a 10% penalty per day for late submission of the assignment.**

- **Exams**

The tentative schedule for the midterm exam is **Saturday, November 2 at 9 am**. If you cannot attend the exam you need to inform the instructor before the exam date. Missing the exam will automatically result in a zero mark unless acceptable documentation is presented to justify your absence **before the date of the test**. The instructor will decide what documentations are acceptable. If your document is not acceptable you will receive a zero mark for the exam.

## **8. Academic Regulations, Policies and Support Services**

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

### **8.1 Regulations**

- <http://calendar.carleton.ca/undergrad/regulations/academicregulationsandrequirementsforthebachelorofengineeringdegree/>
- <https://carleton.ca/cee/current-students/current-undergraduate-students/>

### **8.2 Student Rights and Responsibilities**

<https://carleton.ca/studentaffairs/student-rights-and-responsibilities/>

### **8.3 Academic Support Services**

<https://carleton.ca/academics/support/>

## **9. 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](mailto: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).