Western University - Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 2202a – Mechanics of Materials - Course Outline 2021/22

This first course in mechanics of materials introduces the fundamental principles used in the study of the engineering behaviour of structures and mechanical members subjected to slowly applied or steady state loading conditions. The general objectives are for the student to develop ability to:

- apply the knowledge of statics, properties of materials and basic mathematics to analyse the stress-strain behaviour of structural members subjected to slowly applied or steady state loads.
- differentiate between various static loading conditions of simple structures and formulate progressive solutions to quantify their stress-strain behaviour.
- work individually or function in a team to analyse the stress-strain behaviour of simple structural elements under combined loading conditions, to design simple beams to meet specific design needs and effectively communicate the results of this work in coherent and legible design calculations.
- develop awareness of the applications of the skills and techniques introduced in this course in civil engineering practice.
- recognise the need for life-long learning to keep abreast of new developments in the engineering practice and to improve one’s design abilities to solve more complex contemporary engineering problems.

Calendar Copy:

Concept of stress and strain; axially loaded members; second moment of area; elastic torsion of circular shafts; bending and shearing stresses in beams; transformation of stress and strain; stresses in thin-walled pressure vessels; design of beams and introduction to beam deflection. Course Weight: 0.50.

Anti-requisite(s): MME 2202A/B.

Pre-requisite(s): Engineering Science 1022A/B/Y, Applied Mathematics 1413.

Note: It is the student’s responsibility to ensure that all Pre-requisite and Co-requisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the student’s responsibility to ensure that they have not taken a course listed as an Anti-requisite. The students may be dropped from the course or not given credit for the course towards their degree if they violate the Pre-requisite, Co-requisite or Anti-requisite conditions.

Contact Hours:

- 3 lecture hours/week: Lectures will be delivered in-person. If the COVID-19 situation evolves so that in-person course delivery becomes impossible, a revised version of this course outline will be posted on OWL and will supersede this version. Lectures, Quizzes and Tutorials will be used to track student engagement and participation. Review of lecture materials and self-study should take approximately 6 hours per week.
- 3 tutorial hours: A 3-hour in-person tutorial session will be delivered each week. Student attendance of the tutorial is mandatory. Attendance marks will be given for each tutorial.

Instructor:

Dr. M.L. Nehdi, P. Eng., FACI, FCSCE, FEIC, Professor, Office: SEB 3083; mnehdi@uwo.ca. Office hours: by appointment. Students can request in person meetings or online via Zoom.
Textbook and Notes:
- Course notes will be regularly posted on the OWL course website. It is the student’s responsibility to be up to date with the lectures.

Units:
SI units are used in lectures and examinations. Some problems and assignments may be in imperial units.

Course Delivery
The lectures emphasise the construction of meaning rather than information transmission. Hence, students shall independently study the notes and the corresponding chapters in the textbook. This effort is crucial for student success in this course. The tutorial time is dedicated to engaging students in problem solving and applying knowledge.

Specific Learning Objectives: At the completion of the course, the student should be able to:

1. Concept of Stress:
   a) Differentiate between normal, shearing and bearing stresses
   b) Analyse stresses in simple structures
   c) Identify the components of stress under general loading conditions

2. Stress and Strain – Axial Loading:
   a) Determine stress-strain relationships under axial loading using Hooke's Law
   b) Calculate deformations of axially loaded members
   c) Identify and solve simple statically indeterminate problems
   d) Analyse the effects of temperature changes in axial loading conditions
   e) Assess multi-axial loading cases and use the generalised Hooke's Law
   f) Determine the effect of shearing strain
   g) Apply the stress and strain distribution (Saint-Venant's Principle)

3. Torsion
   a) Define and calculate the polar moment of inertia
   b) Compute deformations and stresses in a circular shaft
   c) Analyse statically indeterminate shafts
   d) Determine torsion stresses in thin-walled hollow shafts

4. Pure Bending
   a) Define and calculate centroids and moments of inertia
   b) Discuss the basic assumptions of the engineering bending theory
   c) Compute deformations and stresses in symmetric members
   d) Compute deformations due to transverse loading

5. Transverse Loading
   a) Calculate and graphically represent normal stress distributions
   b) Analyse problems of shear on a horizontal plane
   c) Compute and graphically represent the distribution of shearing stresses in beams

6. Transformations of Stress and Strain
   a) Carryout transformation of plane stresses, define principal stresses and maximum shearing stresses and apply Mohr's circle for plane stress
   b) Carryout transformation of plane strain, define principal strains and maximum shearing strains and apply Mohr's circle for plane strain
   c) Analyse experimentally measured strain, discuss and interpret results

7. Design of Beams
   a) Determine bending moments and shear force diagrams for a given span and loading
b) Define relations among load, shear and bending moment

c) Identify and compute principal stresses in beams

8. Deflection of Beams (time permitting)

   a) Analyse the deformation of a beam under transverse loading
   b) Analyse and design statically indeterminate beams
   c) Apply superposition to assess deflections/stresses due to various load combinations

General Learning Objectives

E=Evaluate, T=Teach, I=Introduce

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Evaluation:

The final course mark will be determined as follows:

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<td>Three Quizzes</td>
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<td>Mid-term test</td>
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<td>Written Final Examination</td>
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<td>Attendance, Participation and Engagement</td>
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<td>Total</td>
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Note:

- **Students who have failed an Engineering course (i.e.<50%) must repeat all components of the course.** No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories, if applicable, cannot be resubmitted for grading by the student in subsequent years.

- Should a quiz or test conflict with a religious holiday that a student wishes to observe; the student must inform the instructor of the conflict no later than one week before the scheduled test. For further information on Accommodations for Religious Holidays see: [http://www.uwo.ca/univsec/handbook/appeals/religious.pdf](http://www.uwo.ca/univsec/handbook/appeals/religious.pdf)

1. Quizzes and Examinations

   Three quizzes will be scheduled throughout the term during the tutorial period at the following dates: **September 28; October 26, and November 30**. Quizzes will be closed book.

2. Midterm Exam: The midterm exam is tentatively scheduled during the tutorial period on **November 16**. The midterm exam will be closed book.

3. Missed Quiz or Midterm

   The policy of the department of Civil and Environmental Engineering is that there will be **no make-up for missed quizzes or midterms**. For those that do legitimately miss a quiz or midterm and provide the required supporting documentation, the standard practice will be that the weight of the midterm will be reassigned to the final exam.
4. **Weekly Assignments**
   Assignments will be assigned as **homework and should be solved individually**. A solution for each assignment will be posted on the course website. Students are highly encouraged to solve all assignment questions to do well in the quizzes, midterm test and final exam. Assignments will not be marked.

5. **Use of English:**
   In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work, except for the final examination, may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

**Cheating:**

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

For more information on scholastic offenses, please see:

http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

**Attendance:**

Any student who, in the opinion of the instructor, has not engaged sufficiently in lecture or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

**Accommodation:**

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: Academic Accommodation for Students with Disabilities.

**Academic Consideration for Student Absence**

Students should note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences must be submitted to the Academic Counselling office of a student's Home Faculty.**

For Western University policy on Consideration for Student Absence, see

Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs

and for the Student Medical Certificate (SMC), see:


**Religious Accommodation**

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar.
Contingency plan for an in-person class pivoting to 100% online learning:

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online as determined by the course instructor.

Conduct:

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please turn off your cell phone before coming to a class, tutorial, quiz or exam and refrain from using electronic devices.

On the premises of Western University or at a University-sponsored program, students must abide by the Student Code of Conduct: [http://www.uwo.ca/univsec/board/code.pdf](http://www.uwo.ca/univsec/board/code.pdf)

Consultation:

Students are encouraged to discuss problems with their teaching assistant and/or the Instructor in tutorial sessions. Office hours will be arranged for the students to meet with the Instructor and teaching assistants. Other individual consultation can be arranged by appointment with the instructor.

The document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.

Sickness and Other Problems:

Students should immediately consult with the Instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal. The attachment titled “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is an integral part of this course outline.

Students that are in emotional/mental distress should refer to Mental Health@Western [http://www.uwo.ca/uwocom/mentalhealth/](http://www.uwo.ca/uwocom/mentalhealth/) for a complete list of options about how to obtain help

For more information concerning medical accommodations, please see: [http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf](http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf)

Notice:

Students are responsible for regularly checking their email, course website ([https://owl.uwo.ca](https://owl.uwo.ca)) and notices posted outside the Civil and Environmental Engineering Department Office.

Course breakdown: Engineering Science = 100%.

The document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.