Western University
Faculty of Engineering
Mechatronic Systems Engineering Program

MSE 2212A—Mechanics of Materials

Course Outline 2022–23

Description: Stress and strain, Mohr's stress circle, behavior of structures, axial loading of columns and struts, torsion of shafts, bending of beams, buckling of columns and combined loading of components.

Instructor: Dr. Liying Jiang, P.Eng.
SEB2069C, 519-661-2111 ext. 80422, ljiang55@uwo.ca
Consultation hours: M 1:30pm-3:30pm

Contact Hours: 3 lecture hours, 2 tutorial hours, 0.5 laboratory hours, half course.

Prerequisites: ES 1022a/b/y, AM 1413

CEAB Academic Units: Engineering Science 100%

Required Textbook: Mechanics of Materials, R.C. Hibbeler. 11th edition. Prentice Hall, ISBN 978-0-13-760552-1.

Required Software: None

Recommended References:

Mechanics of Materials: An integrated Learning System, T. A. Philpot, 2nd edition, John Wiley & Sons;
Mechanics of Materials R. R. Craig, JR, 3rd edition, John Wiley & Sons;
Lecture notes.

Learning Outcomes:

Upon successful completion of this course, students will be able to

1. Assimilate fundamental concepts of statics and apply fundamental principles of statics to solve mechanics problems. (KB3, PA2, PA3)
2. Develop skills necessary for stress and strain analysis for mechanical members in a variety of different loading situations (axial, pure bending, torsion, transverse loading and combined loads) within a given material's elastic limit. (KB3, PA2, PA3, I3)
3. Apply these skills to analyze and solve the engineering problems related to the design of various mechanical components. (KB3, PA2, PA3)

General Learning Objectives (CEAB Graduate Attributes):

Knowledge Base	D	Use of Engineering Tools		Impact on Society and the Environment	
Problem Analysis	D	Individual and Team Work		Ethics and Equity	
Investigation	D	Communication Skills		Economics and Project Management	
Design		Professionalism		Life-Long Learning	

Notation: *x* represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Topics and Specific Learning Objectives:

1. **Review of statics**

   At the end of this section, students will be able to:

   a. Understand fundamental concepts of statics, including external loads, internal loads, stress, strain, material properties and stress-strain relation.

   b. Draw free body diagram, use method of sections, write equilibrium equations, determine support reactions and internal loads and calculate stresses.

2. **Axially loaded mechanical member**

   At the end of this section, students will be able to:

   a. Calculate normal stress developed and elastic deformation of axially loaded members.

   b. Solve the problem for the statically indeterminate axially loaded members using superposition principle and force method.

3. **Torsional shaft**

   At the end of this section, students will be able to:

   a. Calculate shear stress developed and twist angle of torsional shafts.

   b. Solve the problem for the statically indeterminate torsional shafts using compatibility condition.

4. **Bending beam**

   At the end of this section, students will be able to:

   a. Draw shear and bending moment diagrams, calculate bending stress and shear stress developed and deflection of bending beams.

   b. Solve the problem for the statically indeterminate bending beams using different methods.

5. **Mechanical members subjected to combined loading**

   At the end of this section, students will be able to:

   a. Determine state of stress for material point using superposition principle.

   b. Calculate the stresses developed for pressured vessels.

6. **Stress transformation**

   At the end of this section, students will be able to:

   a. Understand the concepts of state of stress, stress element, principal stresses and planes, stress transformation.

   b. Plot stress element, perform stress transformation to determine the stress components acting on oriented plane, the principal stresses, and maximum shear stresses.

7. **Buckling column**

   At the end of this section, students will be able to:

   a. Calculate the critical buckling load for columns with various end supports.

   b. Determine possible failure modes of compressive columns.

Evaluation:

Course Component	Weight
Homework Assignments	5%
Quizzes	15%
Laboratory	10%
Midterm Test	20%
Final Examination	50%

Homework Assignments: Six assignments, which will be assigned and collected every two weeks (tentative schedule). Assignments should be submitted to the course locker.

Assign 1: due Sept. 23; Assign 2: due Oct. 7; Assign 3: due Oct. 21; Assign 4: due Nov 11; Assign 5: due Nov. 25; Assign 6: Dec. 8

Quizzes: Three quizzes will be given during the tutorial hours, which are closed book and formula sheets will be provided. Only non-programmable calculators are permitted.

Quiz 1: on Sept. 23 during the tutorial hours
Quiz 2: on Oct. 14 during the tutorial hours
Quiz 3: on Nov. 18 during the tutorial hours

Laboratory: Two short lab reports (Lab 1 and Lab 2) and one full-length lab report (Lab2) are requested to submit.

Laboratory 1: in the week of Oct. 17-Oct.21
Laboratory 2: in the week of Nov. 14-Nov. 18
Laboratory 3: in the week of Nov. 28-Dec. 2

Midterm Test: One 2-hour closed book midterm exam. Formula sheets will be provided, and non-programmable calculators are permitted.

Time: 6:30 pm-8:30 pm on Oct 28; Place: TBA

Final Examination: The final examination will take place during the regular examination period. It is a 3-hour closed book exam. Formula sheets will be provided, and non-programmable calculators are permitted.

Course Policies: The following course-specific policies will be enforced throughout the course:

Assignments:

- Assignments are due by 5 pm on due days;
- Late submissions of assignments will receive a grade no higher than 50% for that assignment;
- Missing of an assignment without academic consideration will translate into a zero mark for that assignment;
- Missing of an assignment with academic consideration will only account for the completed assignments for the assignment weighted mark;

Laboratory sessions:

- Reports are due by 5 pm on due days (will be posted on OWL);
- Late submissions of lab reports will receive a grade no higher than 50% for that lab session;
- Late shows up in the lab after 15 minutes will get no higher than 50% for that lab session;
- Missing of a laboratory session without academic consideration will result in a zero mark for that laboratory session;
- Students who miss a lab with academic consideration are required to reschedule the lab by contacting the course instructor no later than 2 days after that lab. Failure to do so will result in a zero mark for that lab.

Quizzes:

- No make-up quiz option will be offered regardless of the circumstances for which the quiz was missed;
- Missing of a quiz without academic consideration will translate into a zero mark for that quiz;
- Missing a quiz with academic consideration will automatically re-weigh the missing quiz(zes) to the midterm exam.

Midterm test:

- No make-up midterm option will be offered regardless of the circumstances for which the midterm was missed;
- Missing the midterm with academic consideration will determine automatic reweighting to the final exam;
- Missing the midterm without academic consideration will result in a grade of zero for the midterm.

Final examination:

- To obtain a passing grade in the course, a mark of 60% or more must be achieved on the final examination. A final examination mark < 60% will result in a final course grade of 48% or less.

If the above conditions are not met, your final grade cannot be greater than 48%. Students who have failed this course (i.e., final average < 50%) must repeat all components of the course.

Use of English: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work with the exception of 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.

Attendance: All classes, laboratories, and tutorials are mandatory unless otherwise stated. Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the program, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: Students should immediately consult with the instructor or program Director if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached "Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled"). The student should seek advice from the instructor or program Director regarding how best to deal with the problem. Failure to notify the instructor or program Director immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Cheating and Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Use of Electronic Devices: Turn off all sound for pagers and cell phones. Students may use laptops, tablet computers, or smart phones *only* to access the course OWL site during lectures and

tutorials. Use of *nonprogrammable* calculators *only* is permitted during quizzes and examinations. No other electronic devices may be used at any time during lectures, tutorials, or examinations.

Use of Personal Response Devices ("Clickers"): If clickers are used in a course, include a statement describing how they will be used that conforms to the requirements given on p. 2 and p. 4 of the course outlines policies in the Academic Handbook, http://www.uwo.ca/univsec/pdf/academic_policies/exam/courseoutlines.pdf
Omit this section if your course does not use clickers.

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course 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 cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (https://owl.uwo.ca/portal/) and making themselves aware of any information that is posted about the course. If the student fails to act on information that has been posted on these sites and does so without a legitimate explanation (i.e., those covered under the illness/compassionate form), then there are NO grounds for an appeal.

Accessibility: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services: Office of the Registrar, http://www.registrar.uwo.ca/
Student Development Centre, http://www.sdc.uwo.ca/
Engineering Undergraduate Services, http://www.eng.uwo.ca/undergraduate/
USC Student Support Services, http://westernusc.ca/services/

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.