

**Western University  
Faculty of Engineering  
Department of Electrical and Computer Engineering**

**MSE3360B Finite Element Methods for Mechatronics Systems Engineering  
Course Outline 2022-2023**

**Description:** Overview of the finite element method (FEM) and its use to solve general problems in 2-D and 3-D. Applications include structural mechanics, heat transfer and multi-physics problems. Methods and applications of optimization and support of engineering design are also introduced.

**Instructor:** Dr. Pawel M. Kurowski; Ph.D., P.Eng.  
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Office hours: by appointment

**Academic Calendar Copy:**

Overview of the finite element method (FEM) and its use to solve general problems in 1-D, 2-D and 3-D. Applications include structural mechanics, heat transfer and thermal stress. Methods and applications of commercial FEM programs in support of engineering design and analysis are introduced.

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

**Anti-requisites:** CEE 3384A/B, MME 3360A/B

**Pre-requisites:** ES 1036A/B or Computer Science 1026A/B, Applied Mathematics 2270A/B, MME 2202A/B or MSE 2212A/B, MME 2204A/B or MSE 2214A/B, MSE 2202A/B.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

**CEAB Academic Units:** Engineering Science 80%, Engineering Design 20%.

**Required Textbook:** “Engineering Analysis with SOLIDWORKS Simulation 2022”  
P. Kurowski SDC Publications, ISBN: 978-1-63057-469-7

**Required Software: SOLIDWORKS 2022**

Available on lab computers and for installation on students' computers.

**General Learning Objectives (CEAB Graduate Attributes)**

Knowledge Base	I	Use of Engineering Tools	D	Impact on Society and the Environment	
Problem Analysis	I	Individual and Teamwork		Ethics and Equity	
Investigation	I	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. General steps in the FEM**

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

- a. Identify steps and associated errors common to any FEM project
- b. Verify and validate FEM results

**2. Direct stiffness method**

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

- a. Formulate and solve FEM equations for assembly of spring, truss, and beam elements.
- b. Apply applicable FEM modeling techniques

**3. Applications of solid, shell beam and 2D elements**

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

- a. Use commercial FEM program to select element as required by the analyzed geometry
- b. Define analysis type and implement correct modeling techniques.

**4. Types of analyses: static linear, static nonlinear, thermal stress, modal, linear buckling, thermal**

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

- a. Select the correct type of analysis as required by the analyzed problem
- b. Interface between different types of analysis to solve multi-physics problems.

**5. Using a commercial FEM program to analyze design problems**

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

- a. Implement FEM in a design process
- b. Use FEM as a design tool.

**Evaluation**

Course Component	Weight
Three homework assignments 6% each	18%
SOLIDWORKS Simulation certification test	12%
Midterm Examination	20%
Final Examination	50%

**Assignments:** Three individual assignments due on: 4<sup>th</sup> week, 6<sup>th</sup> week, 11<sup>th</sup> week. Assignments will be submitted on-line to assignment drop box in course OWL

**Late Submission Policy:** Assignments and laboratories works will be penalized by 4% of the available marks per day for late submission. Assignments submitted more than 3 days late will not be accepted.

**Certification test:** On-line certification test CSWA-S in the last week of March 2023

**Laboratory:** Laboratories take place every week, students will work on assignment problems assisted by Teaching Assistants and/or by the Course Instructor.

**Tutorial:** as required, by appointment

**Midterm Examination:** Scheduled during the week of March 5, 2023; 2h long, open book examination.

**Final Examination:** The final examination, 3h long, open book examination. It will take place during the regular examination period. To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination. A final examination mark < 50% will result in a final course grade of 48% or less.

**Course policies:** If a student misses the midterm exam with consideration, the weight of the midterm exam will be applied to the final exam. If student misses the midterm exam without consideration, the midterm exam's mark will be zero.

If deadlines for assignments are not being met, two days grace period will be allowed with 5% penalty per day. Delay of more than two days will result in mark zero.

If cheating during the midterm or the final examination is suspected, the student will be required to participate in a one-on-one oral examination with the instructor. The mark obtained in the oral examination will supersede the one obtained during the written examination. If the student refuses his/her participation in the oral examination, the examination will be automatically graded with zero and further academic penalties for scholastic offences will be applied.

Students are required to contact the instructor of the course for any other circumstances that appear to not be covered by the non-exhaustive list above.

**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 (except 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:** 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 department, 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 department Chair 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 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.

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](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](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

**Missed Midterm Examinations:** If a student misses a midterm examination, she or he must follow the Instructions for Students Unable to Write Tests and provide documentation to Undergraduate Services Office within 24 hours of the missed test. If accommodation is granted, the department will decide whether to provide a make-up test or allow reweighting of the test, where reweighting means the marks normally allotted for the midterm will be added to the final exam. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero for the test.

If a student is going to miss the midterm examination for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam.

**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](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)

**Use of Electronic Devices:** Students may use laptops, tablet computers, or smart phones only to access the course OWL site during lectures and tutorials. No other electronic devices may be used at any time during lectures, laboratories, tutorials, or examinations.

**Policy on Repeating All Components of the 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.

**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/](http://www.health.uwo.ca/mental_health/), for a complete list of options about how to obtain help.

**Copy Rights:** Lecture notes are copyrighted to the instructor and hence they are legally protected. As such, the unauthorized posting and sharing of the copyrighted course content could be subjected to legal actions. Along the same lines, the recording of the on-line live/synchronous sessions of the course is strictly prohibited.

**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 cannot be resubmitted for grading by the student in subsequent years.

### **Course delivery with respect to the COVID-19 pandemic**

Although the intent is for this course to be delivered in-person, the changing COVID-19 landscape may necessitate some or all of the course to be delivered 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 assessments affected will be conducted online as determined by the course instructor.

**When deemed necessary**, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at: <https://remoteproctoring.uwo.ca>.