Western University
Faculty of Engineering
Department of Mechanical and Materials Engineering

MME3360B Finite Element Methods for Mechanical 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.
Room: SEB2057A
Email: pkurows@uwo.ca
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 (12 laboratories per semester)
2 tutorial hours (per request), 0.5 course.

Anti-requisites: CEE 3384A/B, MSE 3360A/B

Pre-requisites: ES 1036A/B or Computer Science 1026A/B, Numerical and Mathematical Methods 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 if 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: ISBN: 978-1-63057-469-7

Required Software: SOLIDWORKS 2022
Available in computer labs 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 5% each	15%
SOLIDWORKS Simulation certification test	15%
Midterm Examination	20%
Final Examination	50%

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

Certification test: On-line SOLIDWORKS Simulation certification test CSWA-S during 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 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.

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

For more information concerning accommodations for religious holidays, seethe 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: Students may use laptops, tablet computers, or smart phones only to access the course OWL site during lectures, laboratories 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, 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.