DESCRIPTION
Through this course, students are expected to: 1) to develop a critical understanding of the theoretical basis of finite element modelling, 2) to become familiar with the mathematical basis behind high quality finite element modelling aside from using commercial/open-source finite element software packages. Learning commercial/open-source finite element software is NOT covered in this course.

ENROLLMENT RESTRICTIONS
Enrollment in this course is restricted to graduate students in Mechanical and Materials Engineering and Biomedical Engineering.

Materials taught are heavily relied on topics in linear algebra and continuum mechanics. Students need to be versed in these topics as this course is heavily about fundamentals and theories.

INSTRUCTOR CONTACT INFORMATION
Course instructor: H. Mao, Ph.D.
Email address: Haojie.Mao@uwo.ca
Office: TEB365, Tel. 519-661-2111, ext. 80364
Office hours: Fridays (9-10 am), or by appointment

COURSE FORMAT
Face-to-face

TOPICS

<table>
<thead>
<tr>
<th>Topic #</th>
<th>Description</th>
<th>Learning Activities</th>
<th>Tentative timeline*</th>
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</table>
| #1      | General Lecture-Basics of Class, Stress Strain Method | • Lectures  
• Assignments  
• Project | Week 1 |
| #2      | Element Characteristic Matrix Stiffness Method Plane Truss | • Lectures  
• Assignments  
• Project | Week 2 |
| #3      | Shape function | • Lectures  
• Assignments  
• Project | Week 3 |
<table>
<thead>
<tr>
<th>#</th>
<th>Topic</th>
<th>Assessment Tools</th>
<th>Week</th>
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<tbody>
<tr>
<td>#4</td>
<td>Rayleigh Ritz</td>
<td>Lectures, Assignments, Project</td>
<td>Week 4</td>
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<tr>
<td>#5</td>
<td>[N][B][K] and convergence</td>
<td>Lectures, Assignments, Project</td>
<td>Week 5</td>
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<td>#6</td>
<td>Gauss Integration Hourglass Control</td>
<td>Lectures, Assignments, Project</td>
<td>Week 6</td>
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<td>#7</td>
<td>Coordinate System Transformation</td>
<td>Lectures, Assignments, Project</td>
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<td>#8</td>
<td>Gaussian Elimination</td>
<td>Lectures, Project</td>
<td>Week 8</td>
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<td>#9</td>
<td>Dynamics and Vibration</td>
<td>Lectures, Project</td>
<td>Week 9</td>
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<td>#10</td>
<td>Contacts in Complex Dynamic Problem (LS-DYNA)</td>
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<td>#11</td>
<td>Numerical Error and Convergence</td>
<td>Lectures, Project</td>
<td>Week 11</td>
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<td>#12</td>
<td>Application and Optimization</td>
<td>Lectures</td>
<td>Week 12</td>
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* The lectures will be delivered based on the presented order. However, depending on the class progress, the exact weeks of delivery are expected to be flexible.

**SPECIFIC LEARNING OUTCOMES**

<table>
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<tr>
<th>Degree Level Expectation</th>
<th>Weight</th>
<th>Assessment Tools</th>
<th>Outcomes</th>
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</table>
| Depth and breadth of knowledge | 30%    | Term test, Assignment, Project | Understanding of advanced concepts and theories  
Awareness of important current problems in the field of study  
Understanding of computational and/or empirical methodologies to solve related problems |
| Research & scholarship   | 15%    | Project          | Ability to conduct critical evaluation of current advancements in the field of specialization  
Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment |
| Application of knowledge | 20%    | Term test, Assignment, Project | Ability to apply knowledge in a rational way to analyze a particular problem  
Ability to use coherent approach to design a particular engineering approach using existing tools/knowledge |
| Professional capacity / autonomy | 5%     | Project          | Awareness of academic integrity  
Ability to implement established procedures and practices in the coursework  
Defends own ideas and conclusions  
Integrates reflection into his/her learning process |
### Communication Skills

**15%**
- Project
- Class participation
- Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively

### Awareness of Limits of Knowledge

**15%**
- Project
- Awareness of the need of assumptions in complex scientific analyses and their consequences
- Understanding of the difference between theoretical and empirical approaches
- Ability to acknowledge analytical/numerical limitation due to complexity of practical problems

### Assessments

**Assignments (20%)**:
- Four assignments

**Term Test (35%)**:
- Week of March 14, tentative

**Project – Presentation and Report (40%)**:
- Student will select a finite element relevant problem and conduct analysis surrounding the problem using computational, mathematical or theoretical calculations. Topic could be selected in consultation with the course instructor when needed. A brief presentation (10%) will be conducted in the week of March 28. Final report (30%) is due in the week of April 11.

**Class participation (5%)**:
- All the class is expected to participate in lecture, question and answer, and presentation

### Activities in which collaboration is permitted

For paper critique, individual project presentation and final project reports, it’s allowed to consult with each other for inputs on research or techniques during preparation, while eventually students need to finish critique presentation, project presentation and report individually.

### Activities in which students must work alone (collaboration is not permitted)

Students must finish their term tests individually without any sort of collaboration.

### Required Textbook

This course doesn’t require a mandatory textbook

### Optional Course Readings


### Cheating, Plagiarism/Academic Offences

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above
and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence at the following website: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

**CONDUCT**

Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

**HEALTH/WELLNESS SERVICES**

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at [http://www.health.uwo.ca/](http://www.health.uwo.ca/).

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Faculty of Engineering has a Student Wellness Counsellor. To schedule an appointment with the counsellor, contact Kristen Edwards (khunt29@uwo.ca) via confidential email and you will be contacted by our intake office within 48 hours to schedule an appointment.

Students who 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.

**SICKNESS**

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.
Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at: https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html

ACCESSIBLE EDUCATION WESTERN (AEW)
Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): http://academicsupport.uwo.ca/accessible_education/index.html

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.