Western University
Department of Mechanical & Materials Engineering

MME 4474A – Computational Biomechanics for Biomedical Applications

COURSE OUTLINE – 2026-2027

COURSE DESCRIPTION:

This is an undergraduate 4th year course suitable for MME / MSE students (with and without +BME). The objective of course is for students to achieve an advanced understanding of computational methods applied in the field of biomechanics, and to provide hands-on experience using computational biomechanics software. Furthermore, this course aims to expose students to contemporary research literature related to the development or application of computational biomechanics techniques.

COURSE INFORMATION:

Instructor: Dr. Irene Yang, Biomed Eng (Hons I)/BMedSci, DPhil (Oxon)

Office/s & extensions:

Building E4, Room 128A, Victoria Hospital
800 Commissioners Rd E, London
Ontario, Canada
N6A 5W9

Extension: 53610

TEB 349
1151 Richmond Street North, London
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Extension: 88262

Email: irene.yang@uwo.ca

Lectures/tutorials/labs: See Class Schedule

Teaching Assistant (TA): Ms. Alexandra Wu

TA email: awu296@uwo.ca

CONSULTATION HOURS:

- For help with the course content, please contact the TA via email (cc the instructor in all email correspondence) or through messages in OWL Brightspace. For all other assistance, please email the course instructor directly.
- If you are contacting via email, please use your Western email address. Include an academic signature with your full name, program, student ID. We encourage you to include your pronouns to facilitate respectful communication (e.g., he/him; she/her; they/them).
- Office hours: By appointment arrangement via email.
- A general FAQ section on the 'forums' section of OWL Brightspace will be used for students to pose course-related questions. This will ensure that all students enrolled on the course have the same information.

PREREQUISITES:

One of MME 2202A/B or MSE 2212A/B and one of MME 3380A/B or MSE 3380A/B and MME 3360A/B, or enrollment in the Biomedical Engineering program.

Unless you have either the prerequisites 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 fulfil the

necessary prerequisites.

ANTIREQUISITES: None.

ACCREDITATION UNITS: Engineering Science = 100%

TOPICS:

1. Introduction to Computational Biomechanics
2. Medical Imaging, Image Processing
3. Model generation
4. Material assignment
5. Biomechanical Modeling using Finite Element Analysis (FEA)
6. Model Verification and Validation
7. Applications in industry

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

1. Determine joint and muscle loading in 3D space (KB3, KB4, PA1, PA2)
2. Create 3D computational models of geometric bodies as well as human anatomy from medical imaging data (KB4, ET2)
3. Use finite element analysis software to design, validate and analyze a 3D computational model of human anatomy (KB1, KB3, KB4, ET2)
4. Develop an experiment to evaluate bone and tissue mechanical properties including determining loading, and boundary conditions for various activities (IN1, KB3, KB4, PA1, PA2, ITW2, ITW3, CS1, CS2, CS3)
5. Develop sound insight into the field of biomedical and biomechanical engineering, particularly in orthopedic surgery (KB4, IESE1)

The terms in parentheses following each learning outcome refer to Graduate Attributes (GAs) established by the Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. These attributes are used in the accreditation process to ensure that accredited engineering programs are providing the academic requirements for licensure as a professional engineer in Canada. Information on Graduate Attributes and Indicators can be found at GA Indicators. The table below indicates which specific attributes are measured in this course and the level at which it is measured, wherein I=*Introduced*, D=*Developed* and A=*Advanced*/*Applied*

CEAB Graduate Attribute Learning Levels for this course:

Knowledge Base	A	Engineering Tools		Impact on Society	
Problem Analysis	A	Individual & Teamwork		Ethics and Equity	
Investigation	A	Communication	A	Economics & Project Mgmt.	
Design		Professionalism		Life-Long Learning	A

CONTACT HOURS: 3 lecture hours (Tues: 9:30am-11:30am; Wed: 3:30pm-4:40pm), half course

TEXTBOOK: This course has no required/recommended educational materials to purchase.

UNITS: SI will be used; however, English units may be introduced through examples as required.

EVALUATION:

Assessment Type	**Material Covered**	**Tentative Due Date**	**Weight**
In-class mini quizzes	Each quiz will contain technical questions based on material covered previously.	*Assigned mostly bi-weekly in-class* *Due in class*	**15%**
Homework Assignments (three)	Students will learn to develop 3D anatomical models from medical imaging data (MIMICS/3D Slicer), create sophisticated musculoskeletal biomechanical models, and developing / solving structural finite element models of human anatomic systems (ABAQUS).		**40%**
	Assignment 1	*Assigned Week 2* *Due Week 4 (Sept 29th 2026, 09:00 (EDT/GMT-4)*	*10%*
	Assignment 2	*Assigned Week 5* *Due Week 7 (Oct 21st 2026, 09:00 (EDT/GMT-4)*	*15%*
	Assignment 3	*Assigned Week 8* *Due Week 10 (Nov 18th 2026, 09:00 (EDT/GMT-4)*	*15%*
Course Project	Work in teams of 2-3, students will design and complete a project to analyze a biomedical model and use the computational techniques taught in this class to tailor the model as required for the engineering problem, assign appropriate material properties (e.g. cortical and cancellous bone), apply a force and assess model response using FEA with/without other computational software if required. The project grade is further broken down into the following deliverables:		**45%**
	Teams formed	*Due Week 4 (Sept 29th 2026, 09:00 (EDT/GMT-4)*	*0%*
	Proposal, incl. literature review and methods (describing modelling techniques)	*Due Week 7 (Oct 21st 2026, 09:00 (EDT/GMT-4)*	*10%*
	Project presentation to class (during lecture)	*Slides due Week 13 (Dec 8th 2026, 09:00 (EDT/GMT-4)* *Presentation Due in-class*	*15%*

		Week 13 (Dec 8th 2026)	
	Project final report	*Due Week 13 (Dec 9th 2026, 09:00 (EDT/GMT-4)*	*20%*

COURSE POLICIES: The following course-specific policies will be strictly enforced throughout the course:

- Conduct/Class Demeanor
  - The instructor is committed to providing a respectful learning environment for all students involved in this course. This is a collective responsibility of the instructor and students, and therefore students enrolled in this course agree to abide by this criterion. This includes arriving at lectures on time and acting in a professional manner during class.
- Intellectual Property
  - This course contains the intellectual property of the instructor, TA, and/or Western University. Intellectual property includes items such as:
  - Lecture content, spoken and written (and any audio/video recording thereof).
  - Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides).
  - Questions or solution sets from various types of assessments (e.g., assignments, quizzes, labs, tests/final exams, whichever applicable); and
  - Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).
  - The material provided in this course is designed to enhance student learning. The lecture notes and online lecture videos are copyrighted to the instructor and legally protected. You are not permitted under any circumstances to share the course materials on any other website, online forums/ with students taking the same/similar courses in subsequent terms/years. Recording of any sessions delivered on the course without the permission from the instructor is prohibited. In many cases, instructors might be happy to allow distribution of certain materials if permission is sought. Posting and sharing the copyrighted course content without expressed permission from the owner is considered a violation of intellectual property rights and academic integrity and could be subjected to legal actions. Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online.
- Course specific AI policy:

  The course specific AI policy differs from the general Faculty AI policy (see below), and will override the Faculty of Engineering AI Policy where applicable:

  Students must be aware of the potential benefits and limitations of using AI as a tool for learning. AI systems can provide helpful information or suggestions, but they are not always reliable or accurate. Students should critically evaluate the sources, methods, and outputs of AI systems. Students must be aware that generative AI is based on input from other human authors, and therefore, may contain

inaccuracies (e.g. fabricate facts, inaccurately express ideas, and can falsify references to other work), reflect biases etc.

Therefore, all submitted work for this course must be the student's own work, and the student remains accountable for the content and accuracy of all submissions. Students are NOT permitted to submit any course deliverable that has been directly/indirectly generated by AI systems e.g. ChatGPT, Bing Chat, Claude, Google Bard, or any other automated assistance. If clear evidence exists that AI has been used to blindly generate either a component/s of the final course deliverable, e.g. the final work is erroneous, or cannot be explained, the component/s of the final course deliverable will receive a score of 0. This policy will be enforced to ensure equal opportunity and preservation of academic integrity because using AI in this way undermines the student's ability to develop critical thinking, writing, or research skills that are essential for academic success.

- In-class mini quizzes
  - Quiz questions will be released every other week in class only, on odd weeks 1, 3, 5, 7, 9, 11, except for the final quiz which will be held in week 12.
  - Quizzes are delivered using an online platform. Instructions on how to take the quiz will be made clear to you in the lectures.
  - Quizzes will be open book, and you are encouraged to look through the lecture slides to identify the best answer/s. The quizzes are designed to test your understanding of the content covered thus far; questions will be based on content presented in lectures in preceding week/s.
  - If you fail to turn up to class for a quiz, you will receive a grade of 0 for that quiz. No make-up quizzes will be offered.
  - Deadlines: Quizzes will be timed and quiz responses will be due at the end of the timed quiz time. The lowest quiz mark across the term will be dropped.
    - Please note that given this flexibility, any academic consideration requests will be denied.
  - If a minimum of 50% is not obtained on term work (in class weekly quizzes, assignments 1, 2, 3), the student will fail the course irrespective of the mark obtained in the final group project.
- Assignments
  - Students are expected to use the computer labs to complete the assignments.
    - All software required for this course is deployed in AppsAnywhere, which is available on any of our lab computers.
  - Assignments must be submitted individually.
  - Deadlines: Assignments will be due as allocated.
    - Extended penalty-free deadline: Late submissions up to 48 hours after the deadline will not incur a penalty. Thereafter, a penalty of 20% per day will be applied, up to 3 days, after which students will receive a grade of 0.
    - Please note that given this flexibility, any academic consideration requests will be denied.
  - A minimum of 50% is required on term work (in class weekly quizzes, assignments 1, 2, 3) to pass the course, otherwise, the student will fail the course.
- Group project

- Teams must be formed by Week 4 (Sept 29th 2026, 09:00 (EDT/GMT-4). After this time, team members are locked and can no longer be altered.
- It is expected that groups will self-delegate for the various aspects of the project, including problem identification, CAD (if applicable), FEA analysis, and report generation.
- Students who do not choose a team will be assigned to one.
- SolidWorks will be used for the design drawings and layouts, if applicable.
- While the default assumption is that everyone contributes equally to the team effort and that everyone should therefore receive the same mark for the common team submission, if it is deemed by the course instructor or the teaching assistant that individual contributions to the team effort are not equitably shared by the team members, individual adjustment of the marks may occur, with allocation at the discretion of the instructor and teaching assistant.
- The group presentation day is the designated assessment for this course. All students must be present at the group presentation day and each student must present their contribution portion to the group presentation.

  As the **designated assessment** for this course, you may not get academic consideration for the group presentation without providing supporting documentation.

  Failure to turn up without academic consideration will see an immediate individual deduction of 50% of the group presentation score achieved (assuming that there has been equal contribution to other group project components. If not, individual contribution across the group project will first be determined, in addition to the 50% reduction the group presentation score).
- Deadlines: Project deliverables are due as allocated.
  - Extended penalty-free deadline (proposal and report ONLY): Late submissions up to 48 hours after the deadline will not incur a penalty. Thereafter, a penalty of 20% per day will be applied, up to 3 days, after which students will receive a grade of 0.
  - Please note that given this flexibility, any academic consideration requests will be denied.

Generally, students are required to contact the course instructor for any other concerns that are not covered by the non-exhaustive list of circumstances above.

General Faculty / University Policies

The Faculty of Engineering and Western University have overarching policies that prescribe how undergraduate courses should run. The course-specific policies described above should be considered in addition to those overarching policies, or as course-specific interpretations of them. In the event of contradictions or confusion between course-specific policies above and general Faculty / University policies, please contact your course instructor for clarification.

Western Engineering's undergraduate policies can be found by navigating to:
https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/policies.html
and then clicking the "Engineering Undergraduate Policies framework" link.

The policy covers:

- Absence/Late Accommodation Policy
- Religious Accommodation
- Academic Integrity
- Academic Offences
- Faculty of Engineering AI Policy
- Accessibility
- Inclusivity, Diversity, and Respect
- Health and Well-being
- Gender-Based and Sexual Violence