Schulich MEDICINE & DENTISTRY

Western Science

Bachelor of Medical Sciences (BMSc) Program

Department of Medical Biophysics

Human Biomechanics with Biomedical Applications – Medical Biophysics 3330F

Course Syllabus for Fall 2024

THRIVE together

Western University is committed to a **thriving campus**; therefore, your health and wellness matter to us! The following link provides information about the resources available on and off campus to support students: https://www.uwo.ca/health/ Your course coordinator can also **guide you** to resources and/or services should you need them.

1. Technical Requirements:

Laptop or computer

2. Important Dates:

Classes Begin	Reading Week	Classes End	Study day(s)	Exam Period
September 5	October 12–20	December 6	December 7–8	December 9–22

September 30, 2024, is National Day for Truth and Reconciliation and is a non-instructional day
December 2, 2024: Last day to withdraw from a first-term half course without academic penalty

3. Contact Information

Course Coordinator	Contact Information

Instructor(s)	Contact Information
Teaching Assistant	

4. Course Description and Design

Delivery Mode: In-person

DESCRIPTION
The course tackles the mechanical properties of biological structures and fluids in relation to function: deformability, strength, and viscoelasticity of hard and soft tissues, modes of loading and failure. Special topics include mechanics of synovial joints, finite element methods, mechanics of hearing, and mechanics of orthopedic implants and joint replacement.

PREREQUISITES
One of Calculus 1000A/B, Calculus 1500A/B, Mathematics 1225A/B, Numerical and Mathematical Methods 1412A/B, the former Applied Mathematics 1412A/B, the former Applied Mathematics 1413; one of Physics 1201A/B, Physics 1401A/B, Physics 1501A/B, the former Physics 1028A/B, the former Physics 1301A/B; and one of Physics 1202A/B, Physics 1402A/B, Physics 1502A/B, the former Physics 1029A/B, the former Physics 1302A/B. Integrated Science 1001X can be used as a prerequisite in place of Physics 1202A/B. Typically taken in third year, this course is also open to second-year students with an overall average of at least 70% in first year.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may 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.

Timetabled Sessions

Component	Date(s)	Time
Lecture		
Lecture		
Lab/Tutorial		3

☑ Attendance at sessions is required

All course material will be posted to OWL: https://westernu.brightspace.com/d2l/login. Any changes will be indicated on the OWL site and discussed with the class.

If students need assistance, they can seek support on the OWL Brightspace Help. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Current versions of all popular browsers (e.g., Safari, Chrome, Edge, Firefox) are supported with OWL Brightspace; what is most important is that you update your browser frequently to ensure it is current. All JavaScript and cookies should be enabled.

5. Learning Outcomes

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

- Develop understanding of introductory and intermediate concepts and theories of tissue mechanics
- Develop understanding of important current problems in biomechanics
- Develop understanding of computational and/or empirical methodologies to solve biomechanics problems
- Apply knowledge in a rational way to analyze soft and bone tissue stress and understand implications
- Use coherent approach for preliminary design of bone prosthesis components
- Develop understanding of the need of assumptions in complex scientific analyses and their consequence
- Acknowledge analytical limitation due to complexity of tackled problem

6. Course Content and Schedule

Week	Dates	Topic	Instructor
1	Sept 5–8	• Course objectives; learning outcomes and course structure; history and applications	
2	Sept 9–15	• Introduction to Continuum Mechanics – Statics Review • Assignment 1 Tutorial	
3	Sept 16–22	• Structure of Biological Tissue • Building blocks of animal tissues • Elasticity and pure elastic structures • Hooke's law (1D) • Hooke's law (2D)	
4	Sept 23–29	• Elasticity of biological tissue • Tendon, and ligament • Mechanics of skin and blood vessel • Mechanics of tissue as composite materials • Assignment 2 Tutorial	
5	Sept 30–Oct 6	• Measurement of ex vivo soft tissue specimens using indirect methods • Experimental lab: Indentation testing	
6	Oct 7–13	• Midterm Review • Tissue nonlinear behavior: tissue nonlinearity source and modeling • Assignment 3 Tutorial	
7	Oct 14–20	Reading Week (starts October 12th)	
8	Oct 21–Oct 27	• Joint types • Lower-limb biomechanics • Joint mechanics and muscle function • Joint friction and lubrication **Midterm test to be held on Friday, October 25th**	
9	Oct 28–Nov 3	• Introduction to bone mechanics • Bone mechanical properties • Bone stress analysis • Bending and torsion • Combined stress	

10	Nov 4–10	• Stress concentration • Experimental lab: 3-point bending testing • Assignment 4 Tutorial	
11	Nov 11–17	• Bone remodelling and healing • Injury mechanisms	
12	Nov 18–24	• Introduction: Theory and practical issues • FEM workshop • Assignment 5 Tutorial	
13	Nov 25–Dec 1	• Mechanical Challenges in Replacement Joints - Hip replacement • Implant material and implant function • Assignment 6 Tutorial (BME 9529)	
14	Dec 2–6	Review	All

7. Participation and Engagement

- ☑ Students are expected to participate and engage with content as much as possible
- ☑ Students are encouraged to participate during lecture and lab/tutorial sessions
- ☑ Students are also encouraged to participate by interacting in the forums with their peers and instructors
- ☑ To receive full marks in class participation (see Evaluation), you need to attend classes and problem-solving labs/tutorials and actively participate in class activities (e.g., asking and answering questions). Be advised that merely attending classes is not sufficient to earn full mark of class participation

8. Assessment and Evaluation

Below is the evaluation breakdown for the course. Any deviations will be communicated.

Assessment	Format	Weighting	Due Date	Flexibility
Homework Assignments	Written	25%	As posted	Not applicable
Midterm Test	Mixed format	20%	October	Not applicable
Final Examination	Mixed format	50%	TBA	Not applicable
Class participation		5%		Not applicable

Designated Assessment: The following assessment has been designated as requiring supporting documentation:

- Midterm Test

General information about assessments

- ☑ Gradescope will be used for assignment submission and grading
- ☑ When applicable written assignments will be submitted to Turnitin (statement in policies below)
- ☑ Homework assignments can be done collaboratively by groups of students
- ☑ While collaboration groups can include up to four students, no more than two students are permitted to submit one assignment. Assignments submitted by individuals or groups of two in a collaborative group must be substantially different in wording, organization etc. (i.e. submitting identical assignments will NOT be accepted and the individuals/groups will receive a 0 on the submitted assignment).

- ☑ All assignments are due at 11.55pm EST unless otherwise specified
- ☑ Students are responsible for ensuring that the correct file version is uploaded; incorrect submissions including corrupt files could be subject to late penalties (see below) or a 0
- ☑ A student might not receive the same grade as their group members if it is determined that the distribution of work was not equal
- ☑ Assignment grades will be posted regularly through Gradescope and/or the class OWL site. After an assessment is returned, students should wait 24 hours to digest feedback before contacting their evaluator; to ensure a timely response, reach out within 7 days
- ☑ Any grade appeals on assignments or midterms must be received within 2 weeks of the grade being posted.
- ☑ Both the midterm test and final examination will be closed book (closed notes). While the final examination will cover the entire course material, more emphasis will be given to parts that were not included in the midterm test.
- ☑ Use of calculators [HP 48G+ or equivalent/less complex] with no relevant data and program in memory will be allowed.
- ☑ Exam times will be posted on the course OWL Brightspace when available. Students needing to make travel arrangements are advised to book a travel date after the end of the examination period. No makeup exams will be given to accommodate travel.
- ☑ Class Participation: To receive full mark in class participation, you need to attend classes and problem-solving labs/tutorials and actively participate in class activities (e.g., asking and answering questions). Please note that merely attending classes is not sufficient to earn full mark of class participation

Click here for a detailed and comprehensive set of policies and regulations concerning examinations and grading. The table below outlines the University-wide grade descriptors.

A+	90-100	One could scarcely expect better from a student at this level
A	80-89	Superior work which is clearly above average
B	70-79	Good work, meeting all requirements, and eminently satisfactory
C	60-69	Competent work, meeting requirements
D	50-59	Fair work, minimally acceptable
F	below 50	Fail

Information about late or missed assessments:

- ☑ Late assessments without academic consideration will be subject to a late penalty 10%/day
- ☑ An assessment cannot be submitted after it has been returned to the class; an alternate assessment will be assigned OR the weight will be transferred to the final exam
- ☑ One make-up test will be offered OR the weight of a missed test will be transferred to exam
- ☑ Final exam must be passed to pass the course. If the final exam is not passed, the student receives the smaller of 48% and his/her calculated grade

INC (Incomplete Standing): If a student has been approved by the Academic Advising Office (in consultation with the instructor/department) to complete term work at a later date, an INC will be assigned. Students with INC will have their course load in subsequent terms reduced to allow them to complete outstanding course work. Students may request permission from Academic Advising to carry a full course load for the term the incomplete course work is scheduled.

- ☑ **SPC** (**Special examination):** If a student has been approved by the Academic Advising Office to write a Special Examination and the final exam is the only outstanding course component, an SPC will be assigned. If the class has a makeup exam, the student is expected to write the makeup exam. If the class doesn't have a makeup exam or the student misses the makeup exam for reasons approved by the Academic Advising Office, the student will write the exam

the next time the course is offered. Outstanding SPCs will reduce the course load for the term the exam is deferred as outlined in Types of Examinations policy.

9. Communication

- ☑ Students should check the OWL Brightspace site every 24–48 hours
- ☑ Students should email their instructor(s) and teaching assistant(s) using email
- ☑ Emails will be monitored daily; students will receive a response in 24–48 hours
- ☑ This course will use discussions on Brightspace where necessary
- ☑ Where applicable, students should post all course-related queries on the discussion forum so that everyone can access the questions and responses

10. Office Hours

- ☑ Office hours will be held in-person or remotely using zoom
- ☑ Office hours will be held weekly on date and time TBD
- ☑ Office hours will be drop in
- ☑ Office hours will be individual or group

11. Resources

- ☑ All resources will be posted in OWL Brightspace
- ☑ Optional course readings:

  1. Y. C. Fung, Biomechanics, Mechanical Properties of Living Tissues, Second Edition, Springer, 1993
  2. V. C. Mow and R Huiskes, Basic Orthopaedic Biomechanics and Mechanobiology, Third Edition, Lippincott Williams & Wilkins, 2005
  3. C. R. Ethier and C. A. Simmons, Introductory Biomechanics From Cells to Organisms, Cambridge University Press, 2007
  4. R.M. Alexander, Animal Mechanics, Second Editon, Blackwell Scientific Publications, 1983
  5. Y. C. Fung, N. Perrone and M. Anliker (editors), Biomechanics, Its Foundations and Objectives, Prentice Hall Inc., 1972

12. Professionalism & Privacy

Western students are expected to follow the Student Code of Conduct. Additionally, the following expectations and professional conduct apply to this course:

- ☑ All course materials created by the instructor(s) are copyrighted and cannot be sold/shared (e.g., Must Knows Facebook group, Course Hero, Chegg, etc.)
- ☑ Recordings are not permitted (audio or video) without explicit permission
- ☑ Permitted recordings are not to be distributed
- ☑ Students will be expected to take an academic integrity pledge before some assessments. If generative AI is used in their submission, they must include on a title page if and how they used it to support their assignment

Western is committed to providing a learning and working environment that is free of harassment and discrimination. All **students**, staff, and faculty have a role in this commitment and have a responsibility to ensure and promote a safe and respectful learning and working environment. Relevant policies include Western's Non-Discrimination/Harassment Policy (M.A.P.P. 1.35) and Non-Discrimination/Harassment Policy – Administrative Procedures (M.A.P.P. 1.35). Any **student,** staff, or faculty member who experiences or witnesses' behaviour that may be harassment or discrimination **must report the behaviour** to the Western's Human Rights Office. Harassment and discrimination can be human rights-based, which is also known as EDI-based, (sexism, racism, transphobia, homophobia, islamophobia, xenophobia, antisemitism, and ableism) or non-human rights-based (personal harassment or workplace harassment).

13. How to Be Successful in this Class

Students enrolled in this class should understand the level of autonomy and self-discipline required to be successful.

1. Invest in a planner or application to keep track of your courses. Populate all your deadlines at the start of the term and schedule your time throughout the course.
2. Make it a daily habit to log onto OWL Brightspace to ensure you have seen everything posted to help you succeed in this class.
3. Follow checklists created on OWL Brightspace or create your own to help you stay on track.
4. Take notes as you go through the lesson material. Keeping handwritten notes or even notes on a regular Word document will help you learn more effectively than just reading provided course material.
5. Connect with others. Try forming an online study group and try meeting on a weekly basis for study and peer support.
6. Do not be afraid to ask questions. If you are struggling with a topic, check the online discussion boards or contact your instructor(s) and or teaching assistant(s).
7. Reward yourself for successes. It seems easier to motivate ourselves knowing that there is something waiting for us at the end of the task.

14. Western Academic Policies and Statements

A. Absence from Course Commitments

Students must familiarize themselves with the Policy on Academic Consideration – Undergraduate Students in First Entry Programs

Students missing course work for medical, compassionate, or extenuating circumstances can request academic consideration by completing a request at the central academic consideration portal. Students are permitted one academic consideration request per course per term **without** supporting documentation. Note that supporting documentation is **always** required for academic consideration requests for examinations scheduled by the office of the registrar (e.g., December and April exams) and for practical laboratory and performance tests (typically scheduled during the last week of the term).

Students should also note that the instructor may **designate** one assessment per course per term that requires supporting documentation. This designated assessment is described elsewhere in this document. Academic consideration requests may be denied when flexibility in assessment has already been included. Examples of flexibility in assessment include when there are assessments not required for calculation of the final grade (e.g. 8 out of 10 quizzes) or there is flexibility in the submission timeframe (e.g. 72 hour no late penalty period).

Please note that any academic considerations granted in this course will be determined by the instructor of this course, in consultation with the academic advisors in your Faculty of Registration, in accordance with information presented in this course syllabus. Supporting documentation for academic considerations for absences due to illness should use the Student Medical Certificate or, where that is not possible, equivalent documentation by a health care practitioner.

Accommodation for Religious Holidays

Students should review the policy for Accommodation for Religious Holidays. Where a student will be unable to write examinations and term tests due to a conflicting religious holiday, they should inform their instructors as soon as possible but not later than two weeks prior to writing the examination/term test. In the case of conflict with a midterm test, students should inform their instructor as soon as possible but not later than one week prior to the midterm.

Special Examinations

A Special Examination is any examination other than the regular examination, and it may be offered only with the permission of the Dean of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents. To provide an opportunity for students to recover from the circumstances resulting in a Special Examination, the University has implemented Special Examinations dates. These dates as well as other important information about examinations and academic standing can be found here.

B. Academic Offenses

Scholastic offences are taken seriously, and students are directed here to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence.

Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

C. Accessibility Statement

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Accessible Education (AE) at 661-2111 x 82147 for any specific question regarding an accommodation or review The policy on Accommodation for Students with Disabilities

D. Correspondence Statement

The centrally administered **e-mail account** provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner. You can read about the privacy and security of the UWO email accounts here.

E. Discovery Credit Statement

Students are permitted to designate up to 1.0 Discovery Credit course (or equivalent) for pass/fail grading that can be counted toward the overall course credits required for their degree program. The details of this policy and the deadlines can be found here.

F. Essay Course Guidelines

The guidelines for the minimum written assignments refer to the cumulative amount of written work in a course but excludes written work in examinations. You can read about essay course guidelines here.

An essay course must normally involve total written assignments (essays or other appropriate prose composition, excluding examinations) as follows:

- Full course (1000 to 1999): at least 3000 words
- Half course (1000 to 1999): at least 1500 words
- Full course (2000 and above): at least 5000 words
- Half course (2000 and above): at least 2500 words

The structure of the essay course must be such that in order to pass the course, the student must exhibit some minimal level of competence in essay writing and the appropriate level of knowledge of the content of the course.

G. Turnitin and other similarity review software

All assignments will be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in 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 Western University and Turnitin.com.

15. BMSUE Academic Policies and Statements

Cell Phone and Electronic Device Policy (for in-person tests and exams)

The Schulich School of Medicine & Dentistry is committed to ensuring that testing and evaluation are undertaken fairly across all our departments and programs. For all tests and exams, it is the policy of the School that any electronic devices, e.g., cell phones, tablets, cameras, smart glasses, smart watch or iPod are strictly prohibited. These devices MUST be left either at home or with the student's bag/jacket at the front of the room and MUST NOT be at the test/exam desk or in the individual's pocket. Any student found with one of these prohibited devices will receive a grade of zero on the test or exam. Non-programmable calculators are only allowed when indicated by the instructor. The program is not responsible for stolen/lost or broken devices.

Copyright and Audio/Video Recording Statement

Course material produced by faculty is copyrighted and to reproduce this material for any purposes other than your own educational use contravenes Canadian Copyright Laws. You must always ask permission to record another individual and you should never share or distribute recordings.

Rounding of Marks Statement

Across the Basic Medical Sciences Undergraduate Education programs, we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement. ***Final grades*** on this course, irrespective of the number of decimal places used in marking individual assignments and tests, will be calculated to one decimal place and rounded to the nearest integer, e.g., 74.45 becomes 74, and 74.50 becomes 75. Marks WILL NOT be bumped to the next grade or GPA, e.g., a 79 will NOT be bumped up to an 80, an 84 WILL NOT be bumped up to an 85, etc. The mark attained is the mark you achieved, and the mark assigned; requests for mark "bumping" will be denied.

Statement on the use of Generative Artificial Intelligence (AI) Platforms

Within this course, students are permitted to use AI tools exclusively for information gathering and preliminary research purposes. These tools are intended to enhance the learning experience by providing access to diverse information sources. However, it is essential that students critically evaluate the obtained information, exercise independent thinking, and engage in original research to synthesize and develop their own ideas, arguments, and perspectives. The use of AI tools can serve as a starting point for exploration, with students expected to uphold academic integrity by appropriately attributing all sources and avoiding plagiarism. Assignments and/or lab reports should reflect the students' own thoughts and independent written work. By adhering to these guidelines, students contribute to a responsible and ethical learning environment that promotes critical thinking, independent inquiry and allows them to produce original written contributions.

16. Support Services

- Students who are in emotional/mental distress should refer to Mental Health @Western Health https://www.uwo.ca/health/ for a complete list of options about how to obtain help.
- To connect with a case manager or set up an appointment, please contact support@uwo.ca.
- Other important links:
    - Academic Advising (Science and Basic Medical Sciences)
    - Appeal Procedures
    - Registrarial Services
    - Student Development Services
    - Student Health Services

Statement on Gender-Based and Sexual Violence

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at:

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.