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 2022

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	Classes End
Thursday, September 8, 2022	Thursday, December 8, 2022

* November 12, 2022: Last day to drop a first-term half course without academic penalty

Reading Week	Study day(s)	Exam Period
October 31–November 6	December 9	December 10–22

3. Contact Information

Course Coordinator	Contact Information
Dr. Abbas Samani	asamani@uwo.ca

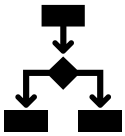
Teaching Assistant	Contact Information
Matthew Caius	mcaius@uwo.ca

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.



Timetabled Sessions

Component	Date(s)	Time	Location
Lecture	Tuesday	11:30am – 12:30am	NCB-293
Lecture	Thursday	11:30am – 1:30pm	NCB-293
Lab/Tutorial	Friday	3:30pm – 5:30pm	NCB-293

☑ Attendance at sessions is required

All course material will be posted to OWL: http://owl.uwo.ca. 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 Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click here.

5. AIMS and OBJECTIVES

Biomechanics is a broad topic, drawing on the laws and principles of mechanics across the whole spectrum of biology – from subcellular biology to large organisms and structures. This course is restricted to human mechanical aspects of biology and biophysics. It is geared toward learning the true mechanical behaviour of tissues, organs and some human body systems, and to recognize these qualities when making assumptions, predicting behaviour and solving problems. Special clinically relevant examples include the orientation-dependent elasticity of skin and its importance to the plastic surgeon, synovial fluid – the magical fluid that lubricates and protects the sliding surfaces of mammalian joints – and interaction between bone and prosthetic material and its impact on the prosthesis longevity.

Our objectives, through assignments, lectures and tutorials, are to demonstrate the basic laws of mechanics and describe the development of internal stresses in tissues under external load with the aim of developing skills in integrating the concepts in mechanics to interpret the behaviour of tissues and anatomical structures. Another objective is to provide exposure to more advanced tools such as FEM software (ABAQUS) to solve complex biomechanics problems.

6. Learning Outcomes

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

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

7. Course Content and Schedule

Week	Dates	Topic	Instructor
Introduction to Biomechanics			
1	Sept 8–11	• Course objectives; learning outcomes and course structure; history and applications. • Introduction to Continuum Mechanics – Static Review	Abbas Samani
Tissue Elasticity			
2	Sept 12–18	• Structure of Biological Tissue • Building blocks of animal tissues • Elasticity and pure elastic structures • Hooke's law (1D)	Abbas Samani
3	Sept 19–25	• Hooke's law (2D) • Elasticity of biological tissue • Bone, tendon, and ligament • Mechanics of skin and blood vessel	Abbas Samani
4	Sept 26–Oct 2	• Mechanics of tissue as composite materials • Measurement of *ex vivo* soft tissue specimens using direct and indirect methods	Abbas Samani
5	Oct 3–9	• Measurement of ex vivo soft tissue specimens using indirect methods • Measurement of soft tissues *in vivo* using elastography	Abbas Samani
6	Oct 10–16	• Tissue nonlinear behavior: tissue nonlinearity source and modeling • Midterm Review	Abbas Samani
Mechanics of Joints			
7	Oct 17–23	• Joint types • Biomechanics of human spine • Lower back muscular contraction • Joint friction • Joint lubrication	Abbas Samani
Bone Mechanics and Bone Fracture			
8	Oct 24–Oct 30	• Introduction to bone mechanics • Bone mechanical properties • Bone stress analysis • Bending and torsion	Abbas Samani
9	Oct 31–Nov 6	Reading Week	N/A
10	Nov 7–13	• Combined stress • Bone repair • Stress concentration	Abbas Samani
Introduction to Finite Element Method (Attendance is not mandatory)			
11	Nov 14–20	• Introduction: Theory and practical issues • FEM workshop	Abbas Samani
Special Topics in Biomechanics			

12	Nov 21–27	• Mechanical Challenges in Replacement Joints - Hip replacement	Abbas Samani
13	Nov 28–Dec 4	• Middle ear biomechanics	Abbas Samani
14	Dec 5–8	• Review	Abbas Samani

8. 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 mark 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). Please note that merely attending classes is not sufficient to earn full mark of class participation

9. Evaluation

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

Assessment	Format	Weighting	Due Date
Homework Assignments (six)	Written	25%	As posted
Midterm Test	Written - Combined	20%	October 14, 2022
Final Examination	Written - Combined	50%	TBA
Class participation		5%	

- ☑ 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 five 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).
- ☑ 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 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

- ☑ Late assignment submission without valid justification will be subject to a late penalty 10%/day
- ☑ 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 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.

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

Information about late or missed evaluations:

- ☑ Late assessments without accommodation will be subject to a late penalty 10 %/day
- ☑ Students who miss work with a weight less than 10% can be considered for assessment item reweighting if they present valid reasons to the course instructor
- ☑ An assessment cannot be submitted after it has been returned to the class; in cases where valid reasons are presented to the instructor reweighting assessment item will be considered.
- ☑ One make-up test will be offered OR the weight of a missed test will be transferred to the final exam.
- ☑ Final exam must be passed to pass the course.. If the final exam is not passed, the student can complete it the next time the course is offered.

INC (Incomplete Standing): If a student has been approved by the Academic Counselling 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 Counselling 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 Counselling 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 Counselling 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.

10. Communication:

- ☑ Students should check the OWL 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 OWL forum for discussions

11. 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

12. Resources

- ☑ All resources will be posted in OWL
- ☑ 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

13. 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 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

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).

14. 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 to ensure you have seen everything posted to help you succeed in this class.
3. Follow weekly checklists created on OWL 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 or watching the videos.
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 and or teaching assistant.
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.

15. Western Academic Policies and Statements

Absence from Course Commitments

A. Absence for medical illness:

Students must familiarize themselves with the Accommodation for Illness Policy.

A student seeking academic accommodation for any **work worth less than 10%** must contact the instructor or follow the appropriate Department specific instructions. Instructors will use good judgment and ensure fair treatment for all students when considering these requests.

If you are unable to meet a course requirement for any **work worth 10% or greater** due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Academic Counseling as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. Please note that the format of a make-up test, exam, or assignment is at the discretion of the course coordinator.

A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Record's Release Form (located in the Dean's Office) for visits to Student Health Services. The form can be found at: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

B. Absence for non-medical reasons:

Student absences might also be approved for non-medical reasons such as religious holidays and compassionate situations. Please review the policy on Accommodation for Religious Holidays. All non-medical requests must be processed by Academic Counselling. Not all absences will be approved; pay attention to the academic calendar and final exam period when booking any trips.

C. 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.

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.

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

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.

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.

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.

Turnitin and other similarity review software

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. Students will be able to view their results before the final submission. 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.

16. 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, i.e., cell phones, tablets, cameras, 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., 74.4 becomes 74, and 74.5 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.

17. Support Services

The following links provide information about support services at Western University.

Academic Counselling (Science and Basic Medical Sciences)

Appeal Procedures

Registrarial Services

Student Development Services

Student Health Services

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.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.