Toronto Metropolitan University

**Department of Electrical, Computer, & Biomedical Engineering**
Faculty of Engineering & Architectural Science

# Course Outline (W2024)

# BME406: Biomechanics

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| **Instructor(s)** | Ahmad Varvani-Farahani [Coordinator]<br>Office: EPH306C<br>Phone: TBA<br>Email: avarvani@torontomu.ca<br>Office Hours: TBA |
| **Calendar Description** | An introduction to the application of mechanical engineering principles to biological materials and systems. Topics include ligament, tendon, bone, muscle; joints, gait analysis; exercise physiology. The basic concepts are directed toward an understanding of the science of orthopedic surgery and sports medicine. |
| **Prerequisites** | BME323 |
| **Antirequisites** | None |
| **Corerequisites** | BLG601 |
| **Compulsory Text(s):** | 1. Orthopaedic Biomechanics: Mechanics and design in Musculoskeletal Systems,D.L. Bartel, D.T. Davy and T.M. Keaveny, Prentice Hall, 2006.<br>2. Professor Varvani Lecture Notes posted in D2L |
| **Reference Text(s):** | 1. Introduction to Biomedical Engineering, M.M. Domach, Prentice Hall, 2004.<br>2. Bioengineering Fundamentals, A. Saterbak, L.V. McIntire, K.Y. San, PrenticeHall, 2007.<br>3. Biomaterials, The intersection of Biology and Materials Science,J.S. Temenoff, A.G. Mikos, Prentice Hall, 2008.<br>4. Tissue Engineering, B.O. Palsson and S.N. Bhatia, Prentice Hall, 2004. |
| **Learning Objectives (Indicators)** | At the end of this course, the successful student will be able to:<br>1. Describes differences between fracture fixation designs and uses specified methods for design of implant such as hip, surface contact in knee joint, stents, and pacemakers. (**4b**)<br>2. Write professionally prepared laboratory reports. Laboratory reports are evaluated on their correctness, completeness, English, and quality of graphics. (**7a**), (**7c**)<br>3. Knows the role of the bioengineering discipline to reduce the risk bone fracture in society particularly elderly people including responsibility for protecting the public interest when it comes to medication and surgical expenses. (**8b**)<br>4. Follows ethical protocols when collecting data. (**10a**)<br>**NOTE:***Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).* |
| **Course Organization** | 3.0 hours of lecture per week for 13 weeks<br>2.0 hours of lab per week for 12 weeks |

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| | 0.0 hours of tutorial per week for 12 weeks |
| **Teaching Assistants** | TBA |
| **Course Evaluation** | <table><tr><td>Midterm Exam</td><td>20 %</td></tr><tr><td>Lab Reports</td><td>25 %</td></tr><tr><td>Assignments</td><td>10 %</td></tr><tr><td>Final Exam</td><td>45 %</td></tr><tr><td>TOTAL:</td><td>100 %</td></tr></table><br>**Note:** In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both **"Theory and Laboratory"** components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the **"Course Evaluation"** section above for details on the Theory and Laboratory components (if applicable). |
| **Examinations** | Midterm exam in/after Week 6, two hours, multiple-choices, closed book (covers Weeks 1-6).<br>Final exam, during exam period, three hours, closed-book (covers Weeks 1-14). |
| **Other Evaluation Information** | None |
| **Other Information** | None |

## Course Content

| Week | Hours | Chapters / Section | Topic, description |
|---|---|---|---|
| 1-2 | 4 | Chapter 1 Sections 1.1-1.8 | Introduction to Biomechanics and Musculoskeletal System |
| 2-3 | 4 | Chapter 2 Sections 2.1-2.4 | Statics and Dynamics in Musculoskeletal System |
| 3-4 | 4 | Chapter 3 Sections 3.1-3.6 | Mechanics of Bone |

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| 4-6 | 6 | Chapter 4 Sections 4.1-4.5 | Mechanics of Cartilage Ligaments Tendons and Skeletal Muscles |
| 6 | 2 | Covers Course Notes Chapters 1.1-4.5 | Midterm test |
| 7 | 3 | Course Notes | Mechanics of Human Heart |
| 8-9 | 5 | Chapters 9 and 10 | Biomechanics of Joints: Spine Knee and Hip |
| 9-11 | 5 | Chapters 7 and 8 Sections 7.1-7.4/8.1-8.4 | Orthopaedic Implants and Fracture Fixation Devices. |
| 11-13 | 6 | Course Notes | Applications: Dental Artificial Heart Stents Hip Replacement |

## Laboratory(L)/Tutorials(T)/Activity(A) Schedule

| Week | L/T/A | Description |
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| 1 | - | No Laboratory in the first week |
| 2 | KHE325 | Introduction to Biomechanics Labs-(Hardness Fatigue Torsion Bending) |
| 3 | KHE325 | Hardness test on bovine femur and rib samples |
| 4 | KHE325 | Three-point bending tests on rib samples |

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| 5 | KHE325 | Torsion test on bovine femur samples |
| 6 | KHE325 | Fatigue test on bovine femur samples |
| 7 | - | Study Week |
| 8 | KHE325 | Introduction to Biomechanics Labs-(EKGEMG Gate Analysis I and II) |
| 9 | KHE325 | Electrocardiogram (ECG or EKG) |
| 10 | KHE325 | Electromyography (EMG) |
| 11 | KHE325 | Gait analysis (I) |
| 12 | KHE325 | Gait analysis (II) |
| 13 | KHE325 | Review on Mechanical Tests (Hardness Fatigue Torsion |

## University Policies & Important Information

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on the Senate website

Refer to the Departmental FAQ page for furhter information on common questions.

## Important Resources Available at Toronto Metropolitan University

- The Library provides research workshops and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the Library's virtual research help service to speak with a librarian.
- Student Life and Learning Support offers group-based and individual help with writing, math, study skills, and transition support, as well as resources and checklists to support students as online learners.

- You can submit an Academic Consideration Request when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the Senate website and select the blue radio button on the top right hand side entitled: **Academic Consideration Request (ACR)** to submit this request.

  *For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate Policy 167: Academic Consideration.*

- If a student is requesting accommodation due to a religious, Aboriginal and/or spiritual observance, they must submit their request via the online Academic Consideration Request (ACR) system **within the first two weeks of the class or, for a final examination, within two weeks of the posting of the examination schedule**. If the required absence occurs within the first two weeks of classes, or the dates are not known well in advance as they are linked to other conditions, these requests should be submitted with as much lead time as possible in advance of the required absence.

- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The Remote Learning Guide for students includes guides to completing quizzes or exams in D2L Brightspace, with or without Respondus LockDown Browser and Monitor, using D2L Brightspace, joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for Faculty and students.

## Accessibility

- Similar to an accessibility statement, use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

### Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about Academic Accommodation Support.
- Learn how to register with AAS.

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about Academic Accommodations versus Academic Consideration and how to access each.

## Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:**24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:**24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via My SSP app or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the Toronto Metropolitan University Mental Health and Wellbeing website.