## Course Outline (F2023)

## BME705: Rehabilitation Engineering

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| **Instructor(s)** | Dr. Kristiina Mai [Coordinator]<br>Office: ENG318<br>Phone: (416) 979-5000 x 556085<br>Email: kvmai@ryerson.ca<br>Office Hours: By appointment |
| **Calendar Description** | Engineering principles underlying the design and utilization of devices for persons with disabilities. Exposure to fabrication and design techniques. Overview of existing technology, including: limb and spinal orthoses, limb prostheses, devices aiding mobility, seating aids, reachers, robotic aids, functional electrical stimulation; sensory aids, uses of microcomputers, workplace/home modifications, devices for the aged. Effects of national policies, and challenges of technology transfer. |
| **Prerequisites** | BLG 601, BME 639, and BME 634 |
| **Antirequisites** | None |
| **Corerequisites** | None |
| **Compulsory Text(s):** | 1. An Introduction to Rehabilitation Engineering, R.A. Cooper, H. Ohnabe, D.A. Hobson, CRC Press, Taylor and Francis, 2006. |
| **Reference Text(s):** | 1. Guyton and Hall Textbook of Medical Physiology, Hall, J.E. et al, Elsevier Inc., recent editionhttps://www.elsevier.ca/ca/product.jsp?isbn=9780323597128 |
| **Learning Objectives (Indicators)** | At the end of this course, the successful student will be able to:<br><br>1. Develop a solution to an open-ended design problem using fundamental engineering knowledge. (**1c**)<br>2. Using specialized engineering knowledge and skills, depict and analyze data with appropriate interpretations. (**1d**)<br>3. Assessment of experimental data consistent with the information available and the constraints/parameters of the problem. (**3b**)<br>4. Evaluate progress and modify designs. (**4a**)<br>5. Analyze data to make decisions. (**5b**)<br>6. Use technical vocabulary related to Rehabilitation Engineering accurately. (**6a**), (**7a**)<br>7. Make concise technical presentations to a peer group. (**7b**)<br>8. Use graphics to analyze and display data. (**7c**)<br>9. Considers economic, social, and environmental factors in decisions. (**8b**), (**9a**)<br><br>**NOTE:**_Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB)._ |

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| **Course Organization** | 3.0 hours of lecture per week for 13 weeks<br>2.0 hours of lab per week for 12 weeks<br>0.0 hours of tutorial per week for 12 weeks | |
| **Teaching Assistants** | TBA | |

| **Course Evaluation** | | |
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| | **Theory** | |
| | Design Project | 5 % |
| | Midterm Exam | 25 % |
| | Final Exam | 30 % |
| | **Laboratory** | |
| | Term project | 20 % |
| | Labs | 20 % |
| | TOTAL: | 100 % |

**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).

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| **Examinations** | Midterm exam in Week 7 during class time, two hours, closed book.<br>Final exam, during exam period, closed-book (all materials with emphasis on second half). |
| **Other Evaluation Information** | In the first month, students will choose a project topic and sign up for their presentation time. Specific details of the term project will be given during class and posted in the BME705 course shell. |
| **Teaching Methods** | Lecture slides will be posted on D2L.<br>Lab manuals and project guidelines will be posted on D2L. |
| **Other Information** | None |

## Course Content

| Week | Hours | Chapters / Section | Topic, description |
|---|---|---|---|
| 1 | 3 | 1, 2 | Introduction to Course and Outline<br>Introduction to Rehabilitation Engineering and Terminology<br>Models and Processes |

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| | | | Clinical Tools and Practice |
| 2 | 3 | 9, 18 | Spinal Cord Injury<br> Combination therapies<br> Neuro-prosthesis: Functional Electrical Stimulation<br> Adaptive Sports |
| 3 | 3 | 3, 5 | Universal Design<br> Accessible Design<br> Design Standards<br> Living environments |
| 4 | 3 | 10 | Vestibular System<br> Human balance and mobility<br> Seated balance<br> Parkinson's disease<br> Transportation |
| 5 | 3 | 11 | Stroke<br> Rehabilitation Robotics<br> Reaching and grasping<br> Brain Computer Interface |
| 6 | 2 | 6, 7, 8 | Patient requirements<br> Wheelchair design<br> Tissue integrity<br> Specialized equipment |
| 7 | 3 | 12 | Prosthetic Devices<br> Midterm Exam (Weeks 1-6) |
| 8 | 3 | 13 | Orthotic Devices<br> Sports rehabilitation |

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| 9 | 3 | 14, 15 | Aids for Visual impairment<br> Sensory substitution<br> Cognitive development aids<br> Aids for Hearing impairment<br> Speech therapy<br> Language and Communication |
| 10 | 3 | 4 | Gut-Brain Axis<br> Microbiome and Health<br> Technology Transfer |
| 11 | 3 | 16, 17 | EEG analysis<br> Diagnostics and Interventions |
| 12 | 3 | | Review<br> Project presentation |

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

| Week | L/T/A | Description |
|---|---|---|
| 3-5 | ENG409 | Lab 1: Electromyography and Functional Electrical Stimulation |
| 6-7 | ENG409 | Lab 2: Posturography: Analysis of accelerometer signals |
| 8-9 | ENG409 | Lab 3: Balance Control: Design of balance control system |
| 10-11 | ENG409 | Lab 4: Speech: Assessment and Rehabilitation |

## University Policies

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

# 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 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](mailto:csdc@torontomu.ca)
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email [osvse@torontomu.ca](mailto: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.