Course Outline

ECE 4610 – Biomedical Instrumentation and Signal Processing

Fall 2026

Instructor
- Zahra Moussavi, P.Eng.
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Office Hours
- By appointment

Teaching Assistant
- Zach Gregoire
  gregoirz@myumanitoba.ca

Contact Hours
- 4 credit hours
- Lectures:
  3 hours x 13 weeks = 39 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours

Prerequisites:
- ECE 2160 Electronics 2E
- ECE 3780 Signal Processing 1

Course Objectives

The goal is to introduce biological systems and apply engineering principles (electrical and mechanical) to the solution of the biomedical problems. The emphasis of this course will be both practical and theoretical. You will design systems to acquire biomedical signals in the laboratory and use this data throughout the course.

Course Content

The following topics will be covered:

- Special problems and requirements for recording and analyzing biological signals, i.e. ECG, EMG, from human subjects.
- The design of instrumentation amplifiers for analog signal conditioning.
- Examination of possible health hazards associated with measurement of biological signals.
- Study of relevant physiology and anatomy of the physiological systems.
- Analysis of biological signals

Textbook

Lecture Notes for ECE 4610, Z. Moussavi, 2021. (Available in the UofM Bookstore.)

Recommended:
Medical Instrumentation Book by John Webster, Wiley
Fundamental of Respiratory Sounds Analysis by Z. Moussavi, Morgan 7 Claypool Publisher Series.

Other Resources

Lecture notes, which will be available on the course web page and will provide the necessary physiology and anatomy, as well as signal analysis background.

Learning Outcomes

1. To be able to build a signal conditioning device for most biological signals.
2. To be able to debug and analyze instrumentation amplifiers.
3. To be able to record and analyze Electromyographic (EMG-muscles') signals.
4. To be able to record and analyze Electroencephalogram (EEG) signals (heart vital signal).
5. To be able to record and analyze heart, respiratory and swallowing sounds.

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	D	D		D	A	A	I	D		I		
2	D	D		D	A	A	I	D		I		
3	D	I	I	I	D	A	I	I		I		
4	D	I	I	I	D	A	I	I	I	I		
5	I	I	I	I	D	A	I	I	I	I		

Traditional Territories Acknowledgement

The University of Manitoba campuses and research spaces are located on original lands of Anishinaabeg, Ininiwak, Anisininewuk, Dakota Oyate, Dene and Inuit, and on the National Homeland of the Red River Métis.

UM recognizes that the Treaties signed on these lands are a lifelong, enduring relationship, and we are dedicated to upholding their spirit and intent. We acknowledge the harms and mistakes of the past and the present. With this understanding, we commit to supporting Indigenous excellence through active Reconciliation, meaningful change, and the creation of an environment where everyone can thrive. Our collaboration with Indigenous communities is grounded in respect and reciprocity and this guides how we move forward as an institution.

Important Dates

- **Term Test**
  TBA
- **Voluntary Withdrawal Deadline**
  November 24th, 2026
- **National Day for Truth and Reconciliation**
  September 30th, 2026
  No classes or examinations
- **Thanksgiving Day**
  October 12th, 2026
  No classes or examinations
- **Remembrance Day**
  November 11th, 2026
  No classes or examinations
- **Fall Term Break**
  November 9th–13th, 2026
  No classes or examinations

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 50%
- Engineering Design: 50%

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and team work
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/ environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

I - Introduced (Introductory)
D - Developed (Intermediate)
A - Applied (Advanced)

Evaluation

The final course grade will be determined from a student's performance in quizzes, lab experiments and assignments, a project, and a final examination. Attendance at lectures is essential to successful completion of this course. To receive a passing grade the student must finish all the components of the course.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Assignments & Laboratories	20	S	1, 2, 3, 4
Midterm	25	F, S	1, 2, 3, 4, 5
Project	15	F, S	1, 2, 3, 4, 5
Final Examination	40	S	1, 2, 3, 4, 5

∗ Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)

CEAB Graduate Attributes Assessed

PA.3 – Analyzes and solves complex engineering problems.
ET.1A – Uses analytical tools to complete engineering activities.

Student Absences

Attendance in lectures, tutorials, and laboratories is mandatory. For short-term absences due to illness or other extenuating circumstances of 120 hours (5 days) or less, students are required to complete a *Self-Declaration Form for Brief or Temporary Absence* available on the University website.🔗 This form must be submitted to the course instructor within 48 hours of the absence. (No additional documentation is required.)
Note that students are responsible to complete any missed work and must consult with the instructor to make appropriate arrangements.
For absences longer than 120 hours, students must contact the instructor and ECE Undergraduate Advisor, Tammy Holowachuk (Tammy.Holowachuk@umanitoba.ca) for further instructions.

Deferred Final Examinations

Students who miss the regular scheduled writing of a final examination, for valid medical or compassionate reasons, may be given the opportunity to write a deferred examination, subject to approval by the Associate Dean (Undergraduate). All requests for a deferred examination must be made within 48 hours of the missed examination, and must follow the procedure described on the Faculty website, without exception. Course instructors do not have the discretion to grant deferred final examinations.
(https://umanitoba.ca/engineering/student-experience#engineering-student-policies)

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations on Academic Integrity* 🔗, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). This includes the unauthorized use of AI when preparing course deliverables. A student found guilty of contributing to cheating by another student is also subject to serious academic penalty. Integrity also applies to respecting copyrighted course content, which should not be distributed without the creator's permission. Uploading content for the purpose of transcription or other AI-enabled features is commonly a violation of the copyright holder's rights.

Grading Scale

Letter	Mark
A+	95–100
A	85–94
B+	80–84
B	70–79
C+	65–69
C	55–64
D	45–54
F	< 45

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Copyright Notice

All materials provided in this course are copyright and are provided under the fair dealing provision of the *Canadian Copyright Act*. This material may not be redistributed in any manner without the express written permission of the relevant copyright holder. This includes recording class sessions for personal use and/or uploading any course materials to a website.

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

Requirements and Regulations

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Resources