Course Outline

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

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

**Prerequisites:**
- ECE 3780 Signal Processing 1

**Course Website:**
http://umanitoba.ca/umlearn

**Traditional Territories Acknowledgement**

*The University of Manitoba campuses and the Department of Electrical and Computer Engineering are located on the original lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Métis Nation.*

*We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.*

# ECE 4850 T05 – Basics of Biological Signal Analysis

Winter 2022

## IMPORTANT NOTICE

Lectures and laboratories in this course will initially be conducted via remote instruction but will return to *in-person instruction* the week of February 28th 2022. All students are required to be present for in-person instruction at that time. Furthermore, University policy requires all students to be fully vaccinated against COVID-19 in order to attend campus and participate in this course.

## Course Objectives

Students will become comfortable with utilizing basic signal processing techniques for analyzing biological signals such as EMG, ECG, EEG or respiratory sounds.

## Course Content

- Classification/Representation of Signals
- Fourier Series Representation of Periodic Signals, Frequency Spectrum
- Aperiodic Signals - Fourier Transform
- Discrete Fourier Transform
- Autocorrelation - Energy/Power Density Spectrum
- Impulse Function/ Impulse Response/ Convolution/ LTI system/ Transfer Function
- Random Signals, Random events, Bayes theorem; probability
- Intro to Random Process: EMG signal/EEG/ECG and sounds signal
- Power Spectral Density of a Random Process
- Basics of Wavelet Analysis (if time permits)

## Reference (optional)

*Biomedical Signal Processing and Signal Modeling*, Eugene N. Bruce, Wiley, 2001

## 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). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

## 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.

## Copyright Notice

## Important Dates

- **Term Test**
  Wednesday, March 9th, 2022
  6:00PM – 8:00PM
- **Voluntary Withdrawal Deadline**
  April 25th, 2022
- **Louis Riel Day**
  February 21st, 2022
  No classes or examinations
- **Spring Break**
  February 22nd – 25th, 2022
  No classes or examinations
- **Good Friday**
  April 15th, 2022
  No classes or examinations

## Accreditation Details

### Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 55%
- Engineering Design: 45%

### 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

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability to rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

## Learning Outcomes

1. To be able to choose proper pre-processing methods for a biological signal.
2. To be able to choose proper signal processing methods for a biological signal.
3. To be able to analyze a biological signal and interpret the results
4. To be able to analyze stochastic signals.

## Expected Competency Levels

| Outcome | KB | PA | IN | DE | ET | IT | CS | PR | IE | EE | EP | LL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 4 | 4 | 4 | 6 | 6 | 3 | 3 | 4 | 6 | 3 | 4 |
| 2 | 4 | 4 | 4 | 4 | 6 | 6 | 3 | 3 | 4 | 6 | 3 | 4 |
| 3 | 4 | 4 | 4 | 4 | 6 | 6 | 3 | 3 | 4 | 6 | 3 | 4 |
| 4 | 2 | 2 | 2 | 4 | 6 | 6 | 1 | 1 | 1 | 6 | 3 | 1 |

## Evaluation

The final course grade is determined by the student's performance on assignments, in laboratories, and on tests and examinations.

*Students must complete all laboratories in order to be eligible to receive a passing grade.*

| Component | Value (%) | Method of Feedback | Learning Outcomes Evaluated |
|---|---|---|---|
| Project | 20 | F, S | 1, 2, 3, 4 |
| Term Test | 30 | F, S | 1, 2, 3, 4 |
| Final Examination | 50 | S | 1, 2, 3, 4 |

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

## CEAB Graduate Attributes Assessed

ET.2 – Evaluates and selects appropriate tools for a given scenario.

EE.2 – Appreciates, articulates and/or resolves issues and dilemmas related to ethics and equity.

## Requirements/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, smart watches, 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*

## 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.