ECE 4610 – Biomedical Instrumentation and Signal Processing

Fall 2021

IMPORTANT NOTICE – Mandatory Requirement to Report
This course will be conducted using remote instruction. Students who are accessing the course from outside of Canada or the USA must notify the instructor and indicate in which country they are located. Access to software may be restricted from some countries and failure to comply with these restrictions may result in criminal prosecution.

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

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.

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

Traditional Territories
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.
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 (ECG) signals (heart vital signal).
5. To be able to record and analyze heart, respiratory and swallowing sounds.

Expected Competency Levels

<table>
<thead>
<tr>
<th>Outcome</th>
<th>KB</th>
<th>PA</th>
<th>IN</th>
<th>DE</th>
<th>ET</th>
<th>IT</th>
<th>CS</th>
<th>PR</th>
<th>IE</th>
<th>EE</th>
<th>EP</th>
<th>LL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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.

CEAB Graduate Attributes Assessed

DE.3 – Develops/implements possible solutions to an open-ended design problem, leading to an appropriate recommendation.

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

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.

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.
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.

Grading Scale

<table>
<thead>
<tr>
<th>Letter</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>95–100</td>
</tr>
<tr>
<td>A</td>
<td>85–94</td>
</tr>
<tr>
<td>B+</td>
<td>80–84</td>
</tr>
<tr>
<td>B</td>
<td>70–79</td>
</tr>
<tr>
<td>C+</td>
<td>65–69</td>
</tr>
<tr>
<td>C</td>
<td>55–64</td>
</tr>
<tr>
<td>D</td>
<td>45–54</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 45</td>
</tr>
</tbody>
</table>

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.