ENGG*4060 Biomedical Signals Processing

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Winter 2020
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - January 05, 2020

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1 Course Details

1.1 Calendar Description

This course will cover the generation of biomedical signals, detection and measurement, and processing. The physiology of electrical signal generation will cover ionic transport in cellular membranes and propagation of electrical signals in cells and tissues. The range of biomedical signals covered includes such common signals as the electromyogram (EMG), the electrocardiogram (ECG), the electroencephalogram (EEG). Detection and measurement will cover electrode technology, instrumentation amplifiers and safety concerns. Processing includes filtering, frequency content analysis, removal of artifacts, signal correlation, and event detection.

Pre-Requisites: ENGG*3390

1.2 Course Description

This course is a course on biomedical signals of the human and body, and analysis of these signals. The main goals of the course are (1) to teach students the fundamental physiological processes of the human body and how biomedical signals are generated, (2) to illustrate the proper instrumentation setup for biomedical signal collection and (3) to illustrate clearly the way biomedical signals may be processed using Matlab and other software packages.

1.3 Timetable

Lectures:	**Section:**	**Time:**	**Location:**
Tuesday/Thursday	ALL	08:30 AM - 09:50 AM	ALEX, Room 309

Labs:	**Section:**	**Time:**	**Location:**

Wednesday	0101	11:30 AM – 01:20 PM	THRN 2307
Monday	0102	02:30 PM –04:20 PM	THRN 2307

1.4 Final Exam

EXAM Thur

02:30PM - 04:30PM (2020/04/13)

Room TBA

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Calvin Young
Email: cyoung02@uoguelph.ca
Office Hours: TBA

Lab Technician: Ahmed Mezil
Email: amezil@uoguelph.ca
Telephone: 519-824-4120 ext. 53729
Office: THRN 2308

2.2 Teaching Assistants

Teaching Assistant: Nicholas Belanger
Email: belangen@uoguelph.ca

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3 Learning Resources

3.1 Required Resources

Course Website (Website)
https://courselink.uoguelph.ca
Course material, news, announcements, and grades will be regularly posted to the ENGG*4060 Courselink site. You are responsible for checking the site regularly.

Biomedical Signal Analysis (Textbook)
R. M. Rangayyan, Second Edition, Wiley.

3.2 Additional Resources

Lab Information (Lab Manual)
The lab information will be posted on Courselink. Students are responsible for printing the lab manuals and having them with you during the laboratory sessions. The lab reports will be submitted on Courselink.

Home Assignments (Notes)
There will be assignments posted in Courselink during the term. The assignments will be submitted via Courselink.

Miscellaneous Information (Other)
Other information related to the ENGG 4060 course will be posted on the Courselink site.

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4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Learn about the genesis of biomedical signals such as the action potential, EMG, ECG, EEG, etc.
2. Study the characteristics of biomedical signals: periodicity, rhythm, epoch, etc.
3. Review basic concepts of signals, systems, and digital filters.
4. Learn and apply signal processing techniques for filtering and noise removal.
5. Learn about detection techniques for events such as the QRS complex.
6. Learn about spectral analysis of biomedical signals.
7. Learn to use and understand the operation of biomedical signal acquisition instrumentation systems.
8. Learn about the ethical handling of biomedical data and general equipment safety.

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome
1	Knowledge Base	1, 2, 3, 4, 5
1.1	Recall, describe and apply fundamental mathematical principles and concepts	3
1.2	Recall, describe and apply fundamental principles and concepts in natural science	1, 2

#	Outcome	Learning Outcome
1.3	Recall, describe and apply fundamental engineering principles and concepts	3, 4, 5
3	Investigation	4, 6
3.2	Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system)	4
3.3	Analyze and interpret experimental data	6
5	Use of Engineering Tools	7
5.1	Select appropriate engineering tools from various alternatives	7
8	Professionalism	8
8.3	Demonstrate professional behaviour	8

4.3 Relationships with other Courses & Labs

Previous Courses:
ENGG*3390

Follow-on Courses:
ENGG*4040; ENGG*4660

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5 Teaching and Learning Activities

5.1 Lecture

Topics: ENG and EMG, ECG, EEG
Learning Outcome: 1, 2

Topics: Acquisition Systems, Continuous- and Discrete-Time Signals
Learning Outcome: 3, 4

Topics: Time- and Frequency-Domain Filtering Techniques
Learning Outcome: 4, 6

Topics: Detection of Waves and Events
Learning Outcome: 5

5.2 Lab

Topics: week 1 no lab

Topics: week 2 no lab

Topics: week 3 Lab 0 Ethics & Safety

Learning Outcome: 8

Topics: week 4 Lab 1 MATLAB

Topics: week 5 no lab

Topics: week 6 Lab 2 EMG

Learning Outcome: 7
Lab 1 due

Topics: week 7 no lab

Topics: week 8 Lab 3 EEG

Learning Outcome: 7
Lab 2 due

Topics: week 9 no lab

Topics: week 10 Lab 4 ECG

Learning Outcome: 7
Lab 3 due

Topics: week 11 no lab

Topics: week 12 no lab

Lab 4 due

5.3 Other Important Dates

Monday, January 6: Classes commence

Monday, February 17 – Friday, February 21: WINTER BREAK

Friday, April 3: Last day of classes. Last day to drop winter semester courses.

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6 Assessments

6.1 Assessment Details

Assignments (5%)
Learning Outcome: 1, 2, 3, 4, 5, 6
There will be several assignments. These are take-home assignments and will be made available on the Courselink site.

Labs (20%)
Learning Outcome: 7, 8
The Purpose of performing the Lab in this course is to verify the concepts learned during the lectures. The detailed lab schedule will be posted on Courselink.

Midterm Exam (20%)
Date: Thu, Feb 13, In class
Learning Outcome: 1, 2
The midterm exam is closed book.

Final Project (20%)
Due: Fri, Mar 27, 11:59 PM
Learning Outcome: 1, 2, 3, 4, 5, 6
The purpose of the final project is to apply signal processing techniques learned during the lectures. Details of the final project will be posted on Courselink.

Final Exam (35%)
Date: Mon, Apr 13, 2:30 PM - 4:30 PM, TBA
Learning Outcome: 1, 2, 3, 4, 5, 6, 7
The final exam is closed book.

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7 Course Statements

7.1 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Missed Midterm Exam: If you miss the midterm due to grounds for granting academic consideration or religious accommodation, the weight of the missed midterm will be added to the final exam. **There will be no makeup midterm tests.**

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab.

Attendance will be taken in the lab. All students are required to demo their lab during their lab session; this demo is graded. If you are not present for your lab and your demo, you will not be allowed to submit a lab report and you will get a zero on that lab. If you miss more than 25% of a lab period due to lateness or by leaving before you have finished the lab, you will be considered absent.

Late Lab Reports: Late submissions of lab reports that are less than 24 hours late will be penalized 50%.

Late submissions of lab reports that are more than 24 hours late will not be accepted.

Passing grade: The passing grade of this course is 50%.

8 School of Engineering Statements

8.1 Instructor's Role and Responsibility to Students

The instructor’s role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests

and labs.

8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars
