ENGG*4060 Biomedical Signals Processing
Winter 2017

UNIVERSITY of GUELPH

School of Engineering

(Revision 0, January 7, 2017)

---

1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Dr. Christopher Collier, Ph.D.
Office: THRN 2405
Email: ccollier@uoguelph.ca
Office hours: By appointment

1.2 Lab Technician

Technician: Phil Watson
Office: THRN 1140
Email: pwatson@uoguelph.ca

1.3 Teaching Assistant

Lab: Calvin Young
Email: cyoung02@uoguelph.ca

---

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*4060 Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources

R. M. Rangayyan, **Biomedical Signal Analysis**, **Second Edition**, Wiley.

2.3 Additional Resources

Lab Information: The lab information will be posted on Courselink. You are responsible for printing the lab manuals and having them with you during the laboratory sessions.

Home Assignments: There will be problem sets posted in Courselink during the term. These problem sets will not be graded, but it is recommended that you do each problem set, as practice problems are the best way to learn the course. The assignments will be submitted via Courselink.

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

2.5 Communication & Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.** As per university regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its student.

---

3 ASSESSMENT

3.1 Dates and Distribution

Assignments (10%): There will be several assignments. These are take-home assignments and will be made available on the Courselink site.

Labs (20%): The Purpose of performing the Lab in this course is to verify the concepts learned during the lectures. The detail schedule will be posted on Courselink.

Midterm Exam (20%): The midterm exam will take place on Thursday, February 16, 2017, in class. The midterm exam is closed book.

Final Exam (50%): The final exam will take place on Tuesday, April 18, 2017, starting at 14:30. Location TBD. The final exam is closed book.

3.2 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%.

---

4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 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.

Prerequisite: ENGG*3390

4.2 Course Aims

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.

4.3 Learning Objectives (LO)

At the successful completion of this course, a student will 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. Explore techniques for the analysis of waveshape and waveform complexity.

7. Learn about spectral analysis of biomedical signals.

8. Learn to use and understand the operation of biomedical signal acquisition instrumentation systems, A/D systems and transducers (electrodes).

9. Learn about the ethical handling of biomedical data and general equipment safety.

4.4 Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1-9	Assignments, Exams
2. Problem Analysis	3, 4, 7	Assignments, Exams, Labs
3. Investigation	3-8	Labs
4. Design	-	-
5. Use of Engineering Tools	3, 4	Labs
6. Communication	-	Labs
7. Individual and Teamwork	-	Labs
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	-	-

4.5 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 (and typically partially-completed) lecture notes will be made available to students on Courselink/D2L but these are not intended to be stand-alone course notes. 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.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures. 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.

Students are not permitted to use laptop computers while in lecture. The only exceptions are for students using laptop computers to take notes. Prior permission from the instructor must be given before using the laptop in lecture. Students are not permitted to use phones during lectures.

4.7 Relationships with other Courses & Labs

Previous Courses:

ENGG*3390

Follow-on Courses:

ENGG*4040; ENGG*4660

---

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:	**Section:**	**Time:**	**Location:**
Tuesday	0101 and 0102	8:30 – 9:50	ALEX 028
Labs:	**Section:**	**Time:**	**Location:**
Friday	0101	8:30 – 10:20	THRN 2131
Wednesday	0102	15:30 – 17:20	THRN 2131

5.2 Lecture Schedule

The following table contains the *tentative* schedule of lecture topics.

Week	**Topic**
1-3	ENG and EMG, ECG and EEG
4-6	Acquisition Systems, Continuous- and Discrete-Time Signals
7, 8	Time- and Frequency-Domain Filtering Techniques
9, 10	Detection of Waves and Events
11, 12	Analysis of Waveform and Waveshape Complexity

5.3 Lab Schedule

This is a *tentative* lab schedule.

Week	**Topic**	**Due date**
1	no lab	
2	no lab	
3	Ethics/safety presentation	
4	Lab 1	
5	no lab	

6	Lab 2	Lab 1 due
Reading Break		
7	no lab	
8	Lab 3	Lab 2 due
9	no lab	
10	Lab 4	Lab 3 due
11	no lab	
12	no lab	Lab 4 due

5.4 Other Important Dates

Monday, January 9, 2017: Classes commence
Monday, February 20, 2017: Winter Break begins
Friday, February 24, 2017: Winter Break ends
Monday, February 27, 2017: Classes resume
Friday, March 10, 2017: Fortieth class day, last day to drop one semester courses
Friday, April 7, 2017: Classes conclude

6 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.

If the laboratory rules are not followed, consequences will include removing access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

7 ACADEMIC MISCONDUCT

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 discourages misconduct. 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.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:

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

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:

http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:

http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

9 RECORDING OF MATERIALS

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

10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index