

ENGG*4060 Biomedical Signals Processing

Winter 2014



(Revision 1: January 06, 2016)

1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: April Khademi, Ph.D., P.Eng.
Office: RICHS 2521, ext. 56746
Email: akhademi@uoguelph.ca
Office hours: TBA on Courselink or by appointment

1.2 Teaching Assistants

GTA	Email	Office Hours
Jesse Knight	jknigh04@uoguelph.ca	TBA on Courselink or by appointment

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

1. R.M. Rangayyan, *Biomedical Signal Analysis: A Case-Study Approach*, 2nd Edition IEEE and Wiley, 2015

2.3 Other Resources

1. A.V. Oppenheim and A.S. Willsky with S. Hamid, *Signals and Systems*, 2nd Edition, Prentice Hall, 1996. [Print-outs to be provided/posted if required]
2. A.V. Oppenheim and R.W. Schafer with J. Buck, *Discrete-Time Signal Processing*, 3rd Edition, Prentice Hal, 2010. [Print-outs to be provided/posted if required]
3. Technical articles and other material [Print-outs to be provided/posted if required]

2.4 Communication & Email Policy

Please use lectures and lab sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the Courselink site. It is your responsibility to check the course website regularly. As per university regulations, all students are required to check their 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

Labs: 20%

See section 5.3 below.

Project: 20%

Final Report: Thurs Apr 7, In Class.

Note: Both paper and electronic copies are to be submitted

Midterm test: 20%

Thurs Mar 03, 11:30-12:50, In Class.

Final Exam: 40%

Wed Apr 16, 02:30PM - 04:30PM, Room TBA on Webadvisor

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>

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

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

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.

Late Lab Reports: Late submissions of lab reports will not be accepted.

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(s): 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

At the successful completion of this course, the student will have demonstrated the ability 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: stationarity, periodicity, rhythm, wavelet, epoch, episode and transient.
3. Review basic concepts of signals, systems and digital filters

4. Learn and apply signal processing techniques for filtering, noise removal, cancellation of interference and characterization of signals.
5. Design and implement techniques for the detection of events such as the QRS complex, heart sounds and murmur, and the dicrotic notch
6. Explore techniques for the analysis of waveshape and waveform complexity
7. Learn about spectral analysis of biomedical signals
8. Investigate pattern classification and decision techniques for computer-aided diagnosis
9. Design, develop and implement computer methods (algorithms) using software for the analysis of biomedical signals.
10. Learn to use and understand the operation of biomedical signal acquisition instrumentation systems, A/D systems and transducers (electrodes).
11. Learn about the ethical handling of biomedical data and general equipment safety.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1-10	Exams, Labs, Project
2. Problem Analysis	3, 4, 5, 6, 7, 8	Exams, Labs, Project
3. Investigation	4, 5, 7, 8, 9, 10	Labs, Project
4. Design	4, 5, 7, 8, 9, 10	Exams, Labs, Project
5. Use of Engineering Tools	4, 5, 7, 8, 9, 10	Labs, Project
6. Communication	-	Labs, Project
7. Individual and Teamwork	-	Labs, Project
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	11	Labs
11. Environment, Society, Business, & Project Management	8, 9	Project
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. Only selected lecture notes will be made available to students on Courselink since much of the course content is best suited to mathematical derivations and examples worked out on the white/black board. Further, the textbook contains more detailed coverage than can be covered in lectures. During lectures, the instructor will expand and explain the content of course material and provide example problems that supplement the textbook coverage. Scheduled classes will be the principal venue to provide information and feedback.

4.6 Students' Learning Responsibilities

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

4.7 Relationships with other Courses & Labs

Previous Courses:

ENGG*3390: Signal processing

Follow-on Courses:

ENGG*4660: Foundations of time domain, one dimensional signal processing

ENGG*4040: Medical imaging modalities

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Tuesday	11:30 – 12:50	MACN, Room 229
Thursday	11:30 – 12:50	MACN, Room 229

Laboratory:

Wednesday	Sec 01	8:30 - 10:20	THRN, Room 2131
Wednesday	Sec 02	02:30PM - 04:20	THRN, Room 2131

5.2 Lecture Schedule

Lectures	Lecture Topics	References	Learning Objectives
1-4	Introduction to Biomedical Signals	Chapter 1	1
5	Concurrent and Correlated Processes	Chapter 2	1,2
6-13,15	DSP Review, Filtering for Removal of Artifacts	Chapter 3, other	3,4
14	Midterm Exam	--	--
16-18	Event Detection	Chapter 4	5
19-21	Analysis of Waveform and Waveform Complexity	Chapter 5	6
22-24	Frequency Domain Characterization of Signals and Systems	Chapter 6	7

5.3 Lab Schedule

Labs are due two weeks after the start date.

Week	Topic
2	Introduction to ethics, lab equipment, safety training
3-4	Lab1: Introduction to Matlab
5,6	Lab2: EMG
7	No lab: Midterm Review
8-9	Lab3: ECG
10-11	Lab4: EEG
12	Term Project/Open Lab

5.4 Other Important Dates

Monday, January 11 2016: First day of school

Monday, February 15 – Friday, February 19 2016: Winter Break

Friday, March 11: drop date – 40th class

Friday, April 8 2014: last day of class

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](tel:519-824-4120) ext. 56208 or email csd@uoguelph.ca or see the website: <http://www.csd.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>