Carleton UNIVERSITY | Department of Systems and Computer Engineering

SYSC 4203
Bioinstrumentation and Signals

Calendar description

Bioinstrumentation and biological signals; instrumentation systems, noise, electrical safety, and biocompatibility; bioelectric signals; biopotential electrodes: material properties, selection, and fabrication; measurement of flow and pressure; data acquisition; signal processing; biomedical imaging technologies; performance and characteristics of bioamplifier systems; major physiological systems and associated measurements.

Includes: Experiential Learning Activity.

Lectures three hours a week, laboratory/problem analysis three hours a week.

http://calendar.carleton.ca/undergrad/courses/SYSC/

Prerequisites

(SYSC 3600 or SYSC 3500 or SYSC 3610) and (ELEC 2507 or ELEC 3605 or SYSC 3203) and fourth-year status in Biomedical and Electrical Engineering or fourth-year status in Biomedical and Mechanical Engineering.

Prior knowledge

Students should:

- Understand basic analog electronics components.
- Are proficient at design of biomedical amplifiers.
- Understand frequency-domain analysis of signals.
- Understand the principles of cardio-vascular and pulmonary anatomy and physiology.

Course objectives

This course will introduce simple biomedical instrumentation systems used for common biomedical signals, including the relevant issues in the design and use of the systems including instrumentation systems, noise, electrical safety, and biocompatibility. It will describe the major physiological systems and associated measurements, focusing on bioelectric signals and their measurement using biopotential electrodes, as well as systems for measurement of flow and pressure. The issues in data acquisition, signal processing and bioamplifier systems will be discussed.

List of topics

- Thorax Anatomy and Physiology
- Electrical Safety, Electrodes. Biological potentials. Electrocardiogram
- Review of Instrumentation & Biopotential Amplifiers
- Muscles & EMG; EEG
- Filters, signal enhancement and noise reduction, QRS-peak detection
- Ensemble averaging
- Measurement of blood pressure and sound
- Measurement of blood flow and volume
- Pulse oxymeters, photoplethysmography. Ultrasound flow measurement
- Measurement of Respiratory system
- Medical Imaging overview: X-rays and nuclear medical imaging

Learning outcomes

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

- Visualize the anatomy and electrophysiology of humans and animals.
- Describe the origin and characteristics of common biological signals.
- Assess the performance of a biopotential acquisition system in terms of noise and interference.
- Appraise biomedical measurement methods for blood pressure, flow, and oxygenation.
- Choose appropriate signal conditioning and processing methods to analyze biomedical signals.
- Build a biomedical system to measure and correlate common biological signals.
- Describe high-level operation of medical imaging systems.
- Understand biomedical safety and standards.

Graduate Attributes (GAs)

The Canadian Engineering Accreditation Board requires graduates of engineering programs to possess 12 attributes at the time of graduation. Activities related to the learning outcomes listed above are measured throughout the course and are part of the department's continual improvement process. Graduate attribute measurements will not be taken into consideration in determining a student's grade in the course. For more information, please visit: https://engineerscanada.ca/.

Graduate Attribute	Learning outcome(s)
1.10.S - Knowledge base: Discipline-specific concept SCE-7: Biomedical Instrumentation	
1.11.S - Knowledge base: Discipline-specific concept SCE-8: Biomedical Systems	
2.1: Problem Analysis: Applied: Problem definition	
2.2: Problem Analysis: Applied: Approach to the problem	
2.3 - Problem analysis: Use of assumptions	
2.4: Problem Analysis: Applied: Interpreting the solution – validity of results	
4.1: Design: Applied: Clear design goals	
4.2: Design: Applied: Detailed design specifications and requirements	
4.4: Design: Applied: Design solution(s)	
4.5: Design: Applied: Design implementation / task(s) definition	
4.6: Design: Applied: Alternate solution(s) definition	

4.7: Design: Applied: Evaluation based on engineering principles	
5.3: Use of Engineering Tools: Applied: Tools for design, experimentation, simulation, visualization, and analysis	
5.4: Use of Engineering Tools: Applied: Information from relevant publications	
5.5: Use of Engineering Tools: Applied: Limitations of such tools and the assumptions inherent in their use	

Accreditation Units (AUs)

For more information about Accreditation Units, please visit: https://engineerscanada.ca/.

The course has a total of 55 AUs, divided into:

- Engineering Science: 50%
- Engineering Design: 50%

Instructor and TA contact

Specific to course offering (tbd)

Textbook (or other resources)

Specific to course offering (tbd)

Evaluation and grading scheme

Specific to course offering (tbd)

Breakdown of course requirements

Specific to course offering (tbd)

Tentative week-by-week breakdown

Specific to course offering (tbd)

General regulations

Specific to course offering (tbd)