Carleton UNIVERSITY | Department of Systems and Computer Engineering

SYSC 3203
Bioelectrical Systems

Calendar description

Biomedical transducers, sensors, and biomedical actuators. Biomaterials and biocompatibility. Amplifier designs: inverting, noninverting, differential, and bioinstrumentation. Amplifier analysis: gain, sensitivity, distortion and stability. Filter design. Sampling and quantization. Electrical machines. Biomedical electrical safety and standards.

Includes: Experiential Learning Activity.

Lectures three hours a week, laboratory three hours a week.

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

Prerequisites

MATH 1005 and (ELEC 2507 or ELEC 3605), and enrolment in Biomedical and Electrical Engineering or Biomedical and Mechanical Engineering, and second-year status in Engineering.

Prior knowledge

Students should:

- Understand linear circuit components.
- Be proficient with linear circuit techniques, including KCL, KVL, and phasor analysis.
- Understand the operation of analog components, including transistors.
- Understand operational amplifier circuits.

Course objectives

This course will introduce simple bioelectric sensors, transducers, amplifiers, filters and other rudimentary electronic circuits used in a typical bioelectric system, develop fundamentals required for design and analysis of amplifier and filtering circuits, develop skills to analyze a given amplifier/filter design, learn to shape signals, understand fundamental principles of electric motors and understand biomedical safety and associated standards.

List of topics

- Review of linear circuits, time-constants

- Bioelectrical safety and standards Isolation circuits, Relays
- Op-amps, Amplifier limitations, static and dynamic
- Amplifier limitations, static and dynamic Instrumentation amplifiers
- Filter design
- Comparators, Triggers
- Mono- and Bistable circuits
- Oscillators
- Electrodes and sensors
- ADCs and Sampling
- Electrical Machines

Learning outcomes

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

- Understand specifications for design of simple bioelectric systems such as amplifier systems, filtering systems.
- Design amplifiers and filters for given specifications.
- Analyze a simple amplifier circuit, filter circuit and provide specifications from the circuit.
- Understand effects of sampling and quantization in a bioelectric system.
- 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)
1.7.S: Knowledge Base: Developed: Electronics and circuits	
1.10.S: Knowledge Base: Developed: Biomedical instrumentation	
1.11.S: Knowledge Base: Developed: Biomedical systems	
2.1: Problem Analysis: Developed: Problem definition	
2.2: Problem Analysis: Developed: Approach to the problem	
2.3: Problem Analysis: Developed: Use of assumptions	
2.4: Problem Analysis: Developed: Interpreting the solution – validity of results	
4.1: Design: Developed: Clear design goals	
4.2: Design: Developed: Detailed design specification and requirements	
4.4: Design: Developed: Design solution(s)	
4.5: Design: Developed: Design implementation / task(s) definition	
4.6: Design: Developed: Alternate solution(s) definition	
4.7: Design: Developed: Evaluation based on engineering principles	
5.4: Use of Engineering Tools: Developed: Information from relevant publications	

6.1: Individual and Team Work: Developed: Personal and group time management	
6.2: Individual and Team Work: Developed: Group culture, group dynamics	
6.3: Individual and Team Work: Developed: Leadership: initiative and mentoring, areas of expertise, and interdisciplinary teams	
7.2: Communication Skills: Developed: Professional documents: writing, design notes, drawings, attributions, and references	
9.4: Impact of Engineering on Society and the Environment: Developed: Health, safety, and risk	

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: 100%

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)