BME3121: BIOMEDICAL SIGNALS AND SYSTEMS

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Biomedical Signals and Systems

Subject Code
BME - Biomedical Engineering
Course Number
3121

Academic Unit
Biomedical Engineering (BME)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2177 - Engineering Mathematics and Statistics and MBE2036/BME2036 Engineering Computing#

Precursors
BME2121 Artificial Intelligence for Biomedical Engineering

Equivalent Courses
Nil

Exclusive Courses
Nil

Additional Information
Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

This course aims to expose students to representation, description, and characteristics of signals and systems, emphasizing on their application to solve biomedical problems. The biological nature of the living creatures allows for systems thinking to be applied to electrical, mechanical, fluid, chemical, thermal and even optical systems. Understanding of biological signals, such as breathing pattern, electrocardiogram (ECG), electromyographic signals, and biomedical images from ultrasound, MRIs and CT-Scans, are vital for biomedical engineering. The scope of the course covers linear time invariant systems in both continuous and discrete domain. Classical methods, including Fourier transforms, Laplace transforms, convolution, and frequency response are used to model and analyze biomedical signals and systems. Analytical approaches will be complemented by computational methods in Matlab, both in the form of tutorial and class projects.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	To give account of continuous-time linear systems as defined by ODEs and Laplace Transforms.			x	
2	To describe the discrete-time systems as defined by Difference Equations and the corresponding Z Transforms.			x	
3	To recognize the analysis of signals and systems in the context of Superposition, Convolution, Fourier Analysis, and Frequency Response.			x	
4	To familiarize and apply computational tools for analysis and processing of signals and systems in biomedical engineering.		x		x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	The main teaching activity.	1, 2, 3	3 hrs/week
2	Tutorial	Seminar-style interactive activity emphasizing on uses of computational tools (Matlab) for modeling and analysis of biomedical signals.	4	1 hr/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignment	1, 2	30	
2	Matlab-based group project (report)	4	20	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

Assignment

Criterion

1. ABILITY to IDENTIFY/CONTRAST continuous-time and discrete-time signals and systems.
2. ABILITY to EMPLOY mathematical tools to analyze continuous-time and discrete-time systems.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Matlab-based group project (report and presentation)

Criterion

1. CAPACITY for SELF-DIRECTED LEARNING to study signals and systems in the context of biomedical engineering.
2. ABILITY to APPLY computational tools to analyze biomedical signals.
3. ABILITY to COMMUNICATE and PRESENT the findings in forms of presentation and written report.

Excellent (A+, A, A-)

High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Examination

Criterion
ABILITY to employ mathematical tools to analyze and understand continuous-time and discrete-time signals and systems for biomedical applications.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus
Signals and Systems, Linear Time Invariant, Laplace Transform, Z Transform, Convolution, Fourier Analysis, Frequency Response, Computational, Matlab, Biomedical, Signal Processing, Biomedical applications.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Oppenheim, Alan V., Alan S. Willsky, and S. Nawab. Signals and Systems (Prentice-Hall signal processing series), 1996.
2	Lathi, Bhagwandas Pannalal, and Roger A. Green. Linear Systems and Signals. Vol. 2. New York: Oxford University Press, 2005.
3	Semmlow, John. Signals and Systems for Bioengineers: A MATLAB-based Introduction. Academic Press, 2011.
4	Bruce, Eugene N. Biomedical Signal Processing and Signal Modeling. Vol. 49. Wiley-Interscience, 2001.