EE3210: SIGNALS AND SYSTEMS

Effective Term
Semester B 2022/23

Part I Course Overview

Course Title
Signals and Systems

Subject Code
EE - Electrical Engineering
Course Number
3210

Academic Unit
Electrical Engineering (EE)

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
MA1201 Calculus and Basic Linear Algebra II
or
MA1301 Enhanced Calculus and Linear Algebra II
or
EE1002 Principles of Electrical Engineering (Only applicable from 2021/22 and thereafter)

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The course aims to introduce the fundamental concepts and tools for analysis of signals and systems, so as to equip students with basic knowledge and skills required in diverse areas such as communication systems, control systems, and signal processing, and in more broad scientific and engineering disciplines.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Classify signals and systems and describe their properties on continuous and discrete domains.	10	x	x	
2	Describe and perform different domain transformations.	40	x	x	
3	Analyze the input-output relationship of linear, time-invariant systems using time-domain techniques and transform methods.	30	x	x	
4	Familiar with analysis and operations of linear, time-invariant systems and their application implications.	20	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	Lectures	Key concepts, properties, and applications are introduced, developed, and analyzed, followed by illustrated examples. Key concepts and properties are reviewed and further demonstrated by problems of varying levels of complexity.	1, 2, 3, 4	3 hrs/wk

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 2)	1, 2, 3, 4	40	
2	#Assignments (min.: 3)	1, 2, 3, 4	20	

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Additional Information for ATs

Remark:
To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

may include homework, tutorial exercise, project/mini-project, presentation

Assessment Rubrics (AR)

Assessment Task

Examination

Criterion

Achieving all CILOs

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Margin

Failure (F)

Nor even reaching Marginal

Assessment Task

Coursework

Criterion

Achieving all CILOs

Excellent (A+, A, A-)

High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Margin

Failure (F)
Not even reaching Marginal

Part III Other Information

Keyword Syllabus

Signals
What is a signal; Operating on functions to produce new functions: composition, linear combinations, series, time scale changes; Basic continuous-time and discrete-time signals; Dirac impulse function, unit step function, complex exponentials; Energy and power signals.

Systems
What is a system; Classification of systems: linear v. nonlinear, time-invariant v. time-varying, causal v. non-casual, memoryless v. memory, stability; Representation of signals in terms of Dirac impulses; Continuous-time LTI systems with the concepts of convolution integral; Discrete-time LTI systems with the concepts of convolution sum; Properties of LTI systems; Systems described by differential and difference equations.

Fourier Analysis for Continuous-Time Signals and Systems
Representation of periodic signals by continuous-time Fourier Series; Approximation of Periodic Signals using Fourier Series and the convergence of Fourier series; Representation of aperiodic and periodic signals by continuous-time Fourier Transform; Properties of the continuous-time Fourier Transform; Frequency response of LTI systems.

Fourier Analysis for Discrete-Time Signals and Systems
Representation of periodic signals by discrete-time Fourier Series; Representation of aperiodic and periodic signals by discrete-time Fourier Transform; Properties of the discrete-time Fourier Transform; Frequency response of discrete-time LTI systems.

The Laplace Transform
Definition of the Laplace Transform; Region of convergence for Laplace Transforms; Inverse Laplace Transform; Geometric evaluation of the Fourier Transform from the pole-zero plot; Properties of the Laplace Transform; Analysis and characterization of LTI systems using the Laplace Transform; Partial fraction Expansion; Solution of differential equations; Transfer function, Stability.

The z-Transform
Definition of the z-Transform; Relationship with Laplace and Fourier transforms; Region of convergence for z-Transforms; Properties of the z-Transform; Inverse z-Transform; Geometric evaluation of the Fourier Transform from the pole-zero plot; Solution of difference equation; Analysis and characterization of LTI systems using z-Transform; Stability; Transformation between continuous-time and discrete-time systems.

Applications
Ideal versus practical filters; High-pass and low-pass filters; Modulation and demodulation; Analysis of Electrical Networks

Reading List

Compulsory Readings

	Title
1	Alan V. Oppenheim and Alan S. Willsky with S. Hamid Nawab: Signals and Systems, 2nd edition, Prentice Hall, 1983.

Additional Readings

	Title
1	Nil