EE4015: DIGITAL SIGNAL PROCESSING

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Digital Signal Processing

Subject Code
EE - Electrical Engineering
Course Number
4015

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
EE3210 Signals and Systems

Precursors
Nil

Equivalent Courses
EE4219 Digital Signal Processing

Exclusive Courses
Nil

Part II Course Details

Abstract

The aim of this course is to provide students with a good foundation and understanding of digital signal processing theories and techniques for analysis and design and to use them in different areas of applications.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify and analyze discrete time signals and systems.		x	x	
2	Process analogue signals with digital signal processing.		x	x	
3	Implement FIR and IIR digital filters.		x	x	
4	Design FIR and IIR filters.		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	Teaching activities are primarily based on lectures followed by practical examples to enable students to relate theory with practice. Concepts and ideas will be reinforced through small group discussion, in-class exercise and demonstration	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	36	
2	#Assignments (min.:3)	1, 2, 3, 4	14	

Continuous Assessment (%)

50

Examination (%)
50

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)
Not 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

Review of signals and systems

Classification of signals and systems, difference equations, impulse response, convolution, frequency response, discrete-time Fourier transform.

z-transform

Region of convergence, properties of z-transform, inverse z-transform, relation to discrete-time Fourier transform, transfer function, poles and zeros, relation to frequency response.

Digitization of analogue signals

Sampling of analogue signals, sampling theorem, aliasing and prefiltering, analogue-to-digital conversion, uniform and non-uniform quantization, analysis of quantization error, reconstruction of analogue outputs, practical considerations of ADC and DAC, digital processing of signals.

Digital filter design

Classification of digital filters, finite impulse response (FIR) and infinite impulse response (IIR) filters, realizations of FIR and IIR digital filters, direct forms, transposed structures, parallel structures, cascade structures, linear phase structures, finite word-length effects.

Properties of FIR filters, magnitude and phase responses, window design methods, frequency sampling design methods.

Properties of IIR filters, magnitude and phase responses, design of analogue filters, analogue to digital transformation, impulse invariant method, bilinear transformation, pre-warping, frequency transformation.

Discrete Fourier Transform

Discrete Fourier Series, Discrete Fourier Transform of finite duration sequences, Fast Fourier Transform, circular convolution, linear convolution and circular convolution, overlap-add and overlap-save methods, computations of convolution and correlation.

Applications of DSP in Communications

Transmultiplexing, echo cancellation, equalization, adaptive echo canceller, adaptive equalizer.

Reading List

Compulsory Readings

	Title
1	Edmund M-K Lai, An Introduction to Digital Signal Processing, McGraw-Hill, 2004
2	H.C.So, Digital Signal Processing: Foundations, Transforms and Filters, with Hands-on MATLAB Illustrations, McGraw Hill, 2011

Additional Readings

	Title
1	Mitra, Sanjit K., Digital Signal Processing: A Computer-Based Approach, Third Edition, McGraw-Hill, 2006
2	Proakis J G and Manolakis D G, Digital Signal Processing: Principles, Algorithms, and Applications, Fourth edition, Prentice Hall, 2007.
3	Oppenheim, A. V., Schafer, R. W., and Buck, J. R., Discrete-time Signal Processing, Second Edition, Prentice Hall, 1999.