

# EE4015: DIGITAL SIGNAL PROCESSING

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## Effective Term

Semester A 2025/26

## 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

EE5410 Signal Processing

## 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 DEC-A1 DEC-A2 DEC-A3 app.)		
1	Identify and analyze discrete time signals and systems.		x	x
2	Process analogue signals with digital signal processing techniques.		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.

### Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	<p>Lectures</p> <p>Students will engage in formal lectures to gain knowledge about digital signal processing principles and techniques.</p> <p>Students will apply these basic digital signal processing principles and techniques in practical examples through in-class exercises.</p> <p>Students will expand and consolidate their knowledge on topics by engaging with home tutorials and assignments that consist of in-depth problems and discussion.</p>	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	30	
2	#Assignments (min.:3)	1, 2, 3, 4	20	

**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.
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