Course Code: **ECL DC303**	Course Title: **Digital Signal Processing**
Semester: 2025-26 (Odd)	Date of Issue: 02-08-2025
Course Coordinator	Dr Vipan Kakkar
Co Faculty / Instructor	

Teaching & Evaluation Scheme

L	T	S/P	C	Minor Duration	Major Duration	Assign ment	Quiz	Midterm Marks	Major Marks	Total Marks
3	0	2	4	1.5 Hours	3.0 Hours	20	20	20	40	100

Significance and Objectives of the Course:

This course aims to expose students to:

1. discrete Fourier transform and its properties
2. the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals.
3. understand Finite word length effects.
4. Design methods of filters and their applications

Course Outcomes:

After successful completion of this course, students shall be able to;

1. apply DFT algorithms for the analysis of digital signals & systems
2. understand IIR and FIR filters
3. characterize finite Word length effect on filters
4. multirate Filters and their applications

UNIT I DISCRETE FOURIER TRANSFORM Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution – methods based on DFT – FFT Algorithms – Decimation in time Algorithms, Decimation in frequency Algorithms – Use of FFT in Linear Filtering.

UNIT II IIR FILTER DESIGN Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.

UNIT III FIR FILTER DESIGN Structures of FIR – Linear phase FIR filter – Fourier series - Filter design using windowing techniques (Rectangular Window, Hamming Window, and Hanning Window), Frequency sampling techniques – Finite word length effects in digital Filters: Errors, Limit Cycle, and Noise Power Spectrum.

UNIT IV FINITE WORDLENGTH EFFECTS Fixed point and floating point number representations – ADC –Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Roundoff noise power – limit cycle oscillations due to product round off and overflow errors – Principle of scaling.

UNIT V DSP APPLICATIONS Multirate signal processing: Decimation, Interpolation, Sampling rate conversion

TEXT BOOK:

John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”,Fourth Edition, Pearson Education / Prentice Hall, 2007.

REFERENCES:

1. Emmanuel C..Ifeachor, & Barrie.W.Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002.
2. Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata Mc Graw Hill, 2007.

NOTE:	End Term Evaluation (Major Exam) shall be carried out in three stages. Midterm (20 marks), and Major (40 marks) exams.
	Assignment Marks shall be awarded on students' work in the form of Case Study / Design problem / Presentation / Quiz, which shall be evaluated by the concerned faculty.

Digital Signal Processing (ECL DC303)

Subject Name	CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Digital Signal Processing (ECLDC303)	**CO1**	H	M	L	M	M	M	M	L	M	M	L	H
	CO2	H	M	H	M	M	M	M	L	M	M	L	H
	CO3	H	M	M	H	L	M	M	L	M	M	L	H
	CO4	H	M	H	H	L	H	H	L	H	M	L	H
	CO5	H	M	H	H	L	M	M	L	H	M	L	H
	H	5	0	3	3	0	1	1	0	2	0	0	5
	M	0	5	1	2	2	4	4	2	3	5	0	0
	L	0	0	1	0	3	0	0	3	0	0	5	0
	Total	45	35	38	41	26	37	37	26	39	35	20	45
	Strength	0.9	0.7	0.76	0.82	0.52	0.74	0.74	0.52	0.78	0.7	0.4	0.9

LECTURE PLAN

Quiz (20 marks)				Assignment (20 marks)	Midterm Exam	Major Exam	Total
Quiz I (5 marks	Quiz II (5 marks	Quiz III (5 marks	Quiz IV (5 marks	2 assignments or one project	20 marks	40 marks	100 marks

	Unit / Topic / Lecture Contents
Week	**Lecture topic**
1st	**Unit I:** Discrete Signals and Systems- Review and matlab examples – Introduction to DFT – Properties of DFT – Circular Convolution –
2nd	methods based on DFT – FFT Algorithms – Decimation in time Algorithms,

3rd	Decimation in frequency Algorithms – Use of FFT in Linear Filtering.
4th	Tutorial examples
5th	Filter types based on frequency response LPF, HPF, BPF, BRF filter
6th	Structures of FIR – Linear phase FIR filter – filter basic equation
7th	windowing techniques (Rectangular Window, Hamming Window, and Hanning Window),.
8th	Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter
9th	Application example – ECG signal processing
10th	Filtering methods using windowing techniques (Rectangular Window, Hamming Window, and Hanning Window),
11th	**Midterm Exam**
12th	Showing of answer scripts after festival break
13th	Frequency sampling techniques – Finite word length effects in digital Filters: Errors, Limit Cycle, and Noise Power Spectrum.
14th	IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives
15th	IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives
16th	Fixed point and floating point number representations – ADC – Quantization- Truncation and Rounding errors -
17th	Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Roundoff noise power – limit cycle oscillations due to product round off and overflow errors – Principle of scaling
18th	Multirate signal processing: Decimation, Interpolation, Sampling rate conversion
19^{th}	Revision week
20^{th}	**Major Exams**

LAB COURSE PLAN

Lan Exam (40 marks)		**Lab Record**	**Viva-Voce**	**Total**
Written	**Lab Performance**	**30 marks**	**30 marks**	**100 marks**

Week	**Details of Experiments Performed**
1st	Generation of various continuous time signals using MATLAB
2nd	Generation of various discrete time signals using MATLAB

3rd	Obtaining linear convolution and correlation of two discrete sequences using inbuilt functions using MATLAB
4th	Obtaining linear convolution of two discrete sequences without using inbuilt functions using MATLAB
5th	Obtaining circular convolution of two discrete sequences with and without using inbuilt functions using MATLAB
6th	compute DFT of a discrete sequence using inbuilt MATLAB functions
7th	compute DFT of a discrete sequence without using inbuilt MATLAB functions
8th	compute IDFT of a discrete sequence using inbuilt MATLAB functions
9th	compute IDFT of a discrete sequence without using inbuilt MATLAB functions
10th	Design Low pass, High pass, Bandpass and Bandstop FIR filters using Rectangular window in MATLAB
11th	**Midterm exams**
12th	Festival Break
13th	Design Low pass, High pass, Bandpass and Bandstop FIR filters using Hamming window in MATLAB
14th	Design Low pass, High pass, Bandpass and Bandstop FIR filters using Bartlett window in MATLAB
15th	Design Butterworth Low pass IIR Filter in MATLAB
16th	Design Butterworth Bandpass and Bandstop IIR Filter in MATLAB
17th	Generate AM signal and FM signal using MATLAB
18th	Revision week
19th	**Lab Exam**