Lovely Professional University, Punjab

Course Code	Course Title	Lectures	Tutorials	Practicals	Credits	
ECE303	DIGITAL SIGNAL PROCESSING	2	0	2	3	
Course Weightage	ATT: 5 CA: 25 MTT: 20 ETT: 50					

Course Focus	EMPLOYABILITY,ENTREPRENEURSHIP,SKILL DEVELOPMENT

Course Outcomes :Through this course students should be able to

CO1 :: illustrate discrete time signals and systems in time domain

CO2 :: analyze signals and systems in transformed domain

CO3 :: develop digital filters using various techniques

CO4 :: examine digital filter implementation structures and concerns

CO5 :: illustrate word length issues in FIR and IIR filters

CO6 :: simulate real life applications using digital signal processing algorithms

	TextBooks (T)		
Sr No	**Title**	**Author**	**Publisher Name**
T-1	DIGITAL SIGNAL PROCESSING PRINCIPLES, ALGORITHMS AND APPLICATIONS	JOHN G PROAKIS, DIMTRIS G MANOLAKIS	PEARSON

	Reference Books (R)		
Sr No	**Title**	**Author**	**Publisher Name**
R-1	DIGITAL SIGNAL PROCESSING	S. SALIVAHAN, A VALLAVARAJ, GNANPIYA	MC GRAW HILL
R-2	DIGITAL SIGNAL PROCESSING-A COMPUTER BASED APPROACH	S. K. MITRA	MC GRAW HILL
R-3	DIGITAL SIGNAL PROCESSING	A.ANAND KUMAR	PHI Learning Pvt Ltd
R-4	DIGITAL SIGNAL PROCESSING - A MODERN INTRODUCTION	ASHOK AMBARDAR	CENGAGE LEARNING

Other Reading (OR)	
Sr No	**Journals articles as Compulsary reading (specific articles, complete reference)**
OR-1	http://home.iitk.ac.in/~nnaik/pdf/Introduction-to-Radar-Lecture-1-Material.pdf , ,

OR-2	https://www.ee.iitb.ac.in/~esgroup/es_mtech02_sem/es02_sem_rep_bhakta.pdf ,

LTP week distribution: (LTP Weeks)	
Weeks before MTE	7
Weeks After MTE	7
Spill Over (Lecture)	4

Detailed Plan For Lectures

Week Number	Lecture Number	Broad Topic(Sub Topic)	Chapters/Sections of Text/reference books	Other Readings, Relevant Websites, Audio Visual Aids, software and Virtual Labs	Lecture Description	Learning Outcomes	Pedagogical Tool Demonstration/ Case Study / Images / animation / ppt etc. Planned	Live Examples
Week 1	Lecture 1	Review on discrete-time signals and systems(signal operations)	T-1 R-3	OR-1 OR-2	Lecture 1 and 2 for Basic Elementary Signals i.e. unit step, unit impulse, unit Ramp, etc and its operations along with simulation in Octave	To make familiar with how to generate signals	Able to know about Octave, Basics of Signal Generation and various data operations.	ECG signal , EEG signal and seismic waves
		Review on discrete-time signals and systems (classification of signals)	T-1 R-3		Lecture 1 and 2 for Basic Elementary Signals i.e. unit step, unit impulse, unit Ramp, etc and its operations along with simulation in Octave	To make familiar with how to generate signals	Able to know about Octave, Basics of Signal Generation and various data operations.	ECG signal , EEG signal and seismic waves
	Lecture 2	Review on discrete-time signals and systems (introduction to systems)	T-1 R-1 R-3		Introduction to systems along with simulation in Octave	To make familiar with how to anylyse systems	Able to know about Octave, Basics of Systems and its applications	Demonstration of “Sa” generation using octave. Single frequency component of DTMF Tone generation
Week 2	Lecture 3	Review on discrete-time signals and systems (classification of systems – linearity, time-invariance, stability)	T-1 R-2 R-3 R-4		classification of systems along with simulation in Octave	To make familiar with how to anylyse systems	Lecturing and Problem solving using Octave simulation	

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Week 2	Lecture 4	Review on discrete-time signals and systems(linear convolution)	T-1 R-3		Linear Convolution along with simulation in MATLAB	Student will learn about the linear of two signals	Lecturing and Problem solving using MATLAB simulation	ECG signal , EEG signal and seismic waves
Week 3	Lecture 5	Fourier analysis using DFT and FFT(z-transform and inverse z-transform)	T-1 R-3		Z-transform and Inverse Z-transform	Student will be able to analyze signal in z-domain and also find out the frequency response of system	Simulation using MATLAB	
	Lecture 6	Fourier analysis using DFT and FFT(frequency analysis)	T-1 R-3		Frequency analysis of a signal	Able to find out the Frequency response i.e. the magnitude and phase response of a signal.	Lecturing and MATLAB Simulation	Pressing a key on the piano's keyboard causes different frequencies.
		Fourier analysis using DFT and FFT(DFT and IDFT)	T-1 R-3		Frequency analysis of a signal	Able to find out the Frequency response i.e. the magnitude and phase response of a signal.	Lecturing and MATLAB Simulation	Pressing a key on the piano's keyboard causes different frequencies.
Week 4	Lecture 7	Fourier analysis using DFT and FFT(DFT properties)	T-1 R-3		Properties of DFT along with simulation in MATLAB and Python	To understand the concept of convolution in DFT	Lecturing and MATLAB Simulation	
	Lecture 8				Test			
Week 5	Lecture 9	Fourier analysis using DFT and FFT(linear convolution using DFT and IDFT)	T-1 R-3		Properties of DFT along with simulation in MATLAB and Python	To understand the concept of convolution in DFT	Lecturing and MATLAB Simulation	Implementation of basic digital signal processing algorithms such as filtering, convolution, and Fourier analysis.
	Lecture 10	Fourier analysis using DFT and FFT(computation of DFT and IDFT using FFT algorithm)	T-1 R-1 R-3 R-4		DFT and IDFT using FFT algorithm	Student will understand the concept of the FFT structure and decimation processes	Lecturing, Problem solving and MATLAB Simulation	
Week 6	Lecture 11	Design of FIR filters(FIR filters design using rectangular window)	T-1 R-3		Low pass, high pass , band pass, band stop, multi-band filter	Able to design filter for given specifications and will be familiar with the concept of using windows	Lecturing and Problem solving, Simulation	FIR filters are use in Multichannel digital audio processing

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Week 6	Lecture 12	Design of FIR filters (hamming window)	T-1 R-3		Low pass, high pass , band pass, band stop, multi-band filter	Able to design filter for given specifications and will be familiar with the concept of using windows	Lecturing and Problem solving, Simulation	FIR filters are use in Multichannel digital audio processing
		Design of FIR filters (hanning window)	T-1 R-3		Low pass, high pass , band pass, band stop, multi-band filter	Able to design filter for given specifications and will be familiar with the concept of using windows	Lecturing and Problem solving, Simulation	FIR filters are use in Multichannel digital audio processing
		Design of FIR filters (blackman window)	T-1 R-3		Low pass, high pass , band pass, band stop, multi-band filter	Able to design filter for given specifications and will be familiar with the concept of using windows	Lecturing and Problem solving, Simulation	FIR filters are use in Multichannel digital audio processing
Week 7	Lecture 13	Design of FIR filters(linear phase response)	T-1 R-3		Symmetric and anti symmetric response, Designing of FIR	Able to design filter which phase is linearly vary with frequency	Lecturing and Problem solving, Discussions	
		Design of FIR filters(pole-zero plot of FIR filter)	T-1 R-3		Symmetric and anti symmetric response, Designing of FIR	Able to design filter which phase is linearly vary with frequency	Lecturing and Problem solving, Discussions	
		SPILL OVER						
Week 7	Lecture 14				Spill Over			
		MID-TERM						
Week 8	Lecture 15	Design of IIR filters(impulse invariant transformation, bilinear transformation)	T-1 R-3		IR Filter design by Impulse invariance and bilinear transformation	Able to know how could convert analog filter to digital filter	Lecturing and Problem solving, Simulation	
	Lecture 16	Design of IIR filters (introduction to butterworth analog filters)	T-1 R-3		Introduction to Butterworth analog filters and its Frequency Response	Characteristics of Analog filter	Lecturing and Problem solving, Simulation	
		Design of IIR filters (designing of low-pass, high-pass, band-pass and band-stop butterworth filter)	T-1 R-3		Introduction to Butterworth analog filters and its Frequency Response	Characteristics of Analog filter	Lecturing and Problem solving, Simulation	
Week 9	Lecture 17	Design of IIR filters (introduction to chebyshev analog filters)	T-1 R-3		ntroduction to Butterworth analog filters and its Frequency Response	Characteristics of Analog filter	Lecturing and Problem solving, Simulation	

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Week 9	Lecture 17	Design of IIR filters (designing of low-pass, high pass, band-pass and band-stop chebyshev filter)	T-1 R-3		ntroduction to Butterworth analog filters and its Frequency Response	Characteristics of Analog filter	Lecturing and Problem solving, Simulation	
	Lecture 18	Filter realization and finite word length effects(direct form-I and form-II realization)	T-1 R-3 R-4		Direct Form Realization	Student will be able to realize FIR and IIR filter structures	Simulation using Octave	
Week 10	Lecture 19	Filter realization and finite word length effects(cascade and parallel form realization)	T-1 R-3 R-4		Cascade and Parallel Form Realization	Student will be able to realize FIR and IIR filter structures	Lecturing and Octave Simulation	
	Lecture 20	Filter realization and finite word length effects (introduction to finite word length effects: quantization noise, input quantization error, coefficient quantization error)	T-1 R-3		Error resulting from rounding and truncation	Analyze their sensitivity to finite precision effects such as input quantization	Lecturing and Problem solving	
Week 11	Lecture 21	Filter realization and finite word length effects (introduction to finite word length effects: quantization noise, input quantization error, coefficient quantization error)	T-1 R-3		Error resulting from rounding and truncation	Analyze their sensitivity to finite precision effects such as input quantization	Lecturing and Problem solving	
	Lecture 22				Assignment - Simulation based			
Week 12	Lecture 23	Filter realization and finite word length effects(overflow and limit cycles)	T-1 R-3		overflow and limit cycles	Analyze their sensitivity to finite precision effects such as input quantization	Lecturing and Problem solving	
	Lecture 24	Applications of signal processing(biomedical signal processing-ECG and EEG)	T-1 R-3		Anatomy of human heart, generation of ECG, EEG and its filtering, Introduction to DIP, applications of DIP, concept of pixel, types of images, image enhancement and segmentation	Anatomy of human heart, generation of ECG, EEG and its filtering, Introduction to DIP, applications of DIP, concept of pixel, types of images, image enhancement and segmentation	Learn to deal with real life signals and apply DSP techniques on them.	

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Week 12	Lecture 24	Applications of signal processing(digital image processing- image enhancement and segmentation)	T-1 R-3		Anatomy of human heart, generation of ECG, EEG and its filtering, Introduction to DIP, applications of DIP, concept of pixel, types of images, image enhancement and segmentation	Anatomy of human heart, generation of ECG, EEG and its filtering, Introduction to DIP, applications of DIP, concept of pixel, types of images, image enhancement and segmentation	Learn to deal with real life signals and apply DSP techniques on them.	
Week 13	Lecture 25	Applications of signal processing(digital image processing- image enhancement and segmentation)	T-1 R-3		Anatomy of human heart, generation of ECG, EEG and its filtering, Introduction to DIP, applications of DIP, concept of pixel, types of images, image enhancement and segmentation	Anatomy of human heart, generation of ECG, EEG and its filtering, Introduction to DIP, applications of DIP, concept of pixel, types of images, image enhancement and segmentation	Learn to deal with real life signals and apply DSP techniques on them.	
	Lecture 26				Project			
Week 14	Lecture 27	Applications of signal processing(image restoration)	T-1 R-1 R-3		Music Synthesis system, echo and chorus (reverberation) generation)	Students will be able to learn basics of image restoration, music synthesis system, echo and chorus (reverberation) generation)	Octave Simulations	
		Applications of signal processing(digital communication- mobile phone signal processing and RADAR with their block diagrams)	T-1 R-1 R-3		Study of digital communication, Music Synthesis system, echo and chorus (reverberation) generation)	Students will be able to learn basics of digital communication, music synthesis system, echo and chorus (reverberation) generation)	Octave Simulations	
		Applications of signal processing(echo and chorus (reverberation) generation)	T-1 R-1 R-3		Study of digital communication, Music Synthesis system, echo and chorus (reverberation) generation)	Students will be able to learn basics of digital communication, music synthesis system, echo and chorus (reverberation) generation)	Octave Simulations	

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Week 14	Lecture 27	Applications of signal processing(music synthesis system)	T-1 R-1 R-3		usic Synthesis system, echo and chorus (reverberation) generation)	able to learn basics of music synthesis system, echo and chorus (reverberation) generation)	Octave Simulations	
		SPILL OVER						
Week 14	Lecture 28				Spill Over			
Week 15	Lecture 29				Spill Over			
	Lecture 30				Spill Over			

Scheme for CA:

CA Category of this Course Code is:C010102 (Total 3 tasks, 1 compulsory and out of remaining 1 best out of 2 to be considered)

Component	Iscompulsory	Weightage (%)	Mapped CO(s)
Project	Yes	50	CO1, CO2, CO3, CO4, CO5, CO6
Assignment - Simulation based	NO	50	CO2, CO3, CO4
Test	NO	50	CO1

Details of Academic Task(s)

Academic Task	Objective	Detail of Academic Task	Nature of Academic Task (group/individuals)	Academic Task Mode	Marks	Allottment / submission Week
Assignment - Simulation based	To check the understanding of students about DFT, and FFT algorithms, FIR and IIR Filters and software simulations.	Design based test, Assignment simulation based Submission: 10 marks Assessment during the class for updating the solution: 20 marks	Individual	Offline	30	10 / 11

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Project	Students will be able to gain hands-on experience in using software tools for processing digital signals as well as images. Also, Students will make project using real life signals	This test is mandatory includes real life applications of signal processing. Project activities planned in this course. -Submission: 10 marks -Assessment during the class for updating the solution: 20 marks	Individual	Online	30	8 / 13
Test	To check the understanding of students on signal representation.	Lecture 1 to Lecture 6	Individual	Offline	30	3 / 4

MOOCs/ Certification etc. mapped with the Academic Task(s)

Academic Task	Name Of Certification/Online Course/Test/Competition mapped	Type	Offered By Organisation
Assignment - Simulation based	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL
Practical Work 1	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL
Practical Work 2	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL
Practical Work 3	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL
Project	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL
Test	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL
Assignment - Simulation based	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL
Project	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL
Test	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	MOOCs	IIT BOMBAY, NPTEL

Where MOOCs/ Certification etc. are mapped with Academic Tasks:
1. Students have choice to appear for Academic Task or MOOCs etc.
2. The student may appear for both, In this case best obtained marks will be considered.

Detailed Plan For Practicals

Practical No	Broad topic	Subtopic	Other Readings	Learning Outcomes
Practical 1	List of Practicals	elementary signals in Octave		Learn to deal with signal processing concepts.
Practical 2	List of Practicals	linear convolution		Learn to deal with signal processing concepts.

Practical 3	List of Practicals	visualisation of simulated signals using FFT		Student will be able to analyze signal in frequency domain and also find out the frequency response of system
Practical 4	List of Practicals	system representation using FFT		Student will be able to analyze signal in frequency domain and also find out the frequency response of system
Practical 5	List of Practicals	frequency representation of real world signals		Student will be able to analyze the frequency response of real life signals
Practical 6	List of Practicals	design of FIR filters using various windows		Able to design filter for given specifications and will be familiar with the concept of using windows
Practical 7	List of Practicals	filtering using FIR filter		Able to design filter for given specifications and will be familiar with the concept of using windows
Practical 8	List of Practicals	design of IIR butterworth filter		Able to know how could convert analog filter to digital filter
Practical 9	List of Practicals	design of IIR chebyshev filter		Students will be design to chebyshev digital filter
Practical 10	List of Practicals	filtering using IIR filter		Students will be design to chebyshev digital filter
Practical 11	List of Practicals	filter transformation		Able to know how to do filter transformation
Practical 12	List of Practicals	echo generation		Student will able to learn basics of echo and chorus signal at different frequencies
Practical 13	List of Practicals	ECG data acquisition and filtering		able to learn basics of ECG data acquisition and filtering
Practical 14	List of Practicals	image operations		able to learn basics of image processing and its operations
	SPILL OVER			
Practical 15	Spill Over			