SIGNALS AND SYSTEMS

III Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AECC02	Core	L	T	P	C	CIA	SEE	Total
		3	1	0	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisites: There are no prerequisites to take this course.

I. COURSE OVERVIEW:

This course integrates the basic concepts of both continuous and discrete time signals and systems. It covers the linear time invariant systems and their analysis in time and frequency domain, mathematical tools, correlation and convolution of signals, sampling techniques. It provides the necessary background needed for understanding the signal processing and communications.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The representation, classification and analysis of continuous, discrete time signals in time and frequency domains.
II. The Fourier transform, Laplace and Z- transforms and their properties to analyze the signals and systems.
III. The temporal and spectral characteristics of Random process and the extraction of Signal from Noise by filtering.
IV. The sampling, quantization and reconstruction requirements for digital signal processing applications

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Summarize** the elementary signals/systems and their generalclassification based on specific characteristics.	Understand
CO 2	**Recall** the analogy between vectors and signals and the orthogonalfunctional space for signal approximation using orthogonal basisfunctions.	Remember
CO 3	**Compute** the correlation functions and energy (power) densityspectrum for analyzing the continuous time signals/systems.	Apply
CO 4	**Make use of** Fourier series and Fourier transform for analyzingsignals and systems in frequency domain.	Apply
CO 5	**Explain** the linear time invariant (LTI) systems using theconcepts of convolution and correlation.	Understand
CO 6	**Analyze** the continuous time signals and the LTI systems inLaplace domain for their system specific characteristics.	Analyze
CO 7	**Analyze** the discrete time signals and the LTI systems in Z-domain for their system specific characteristics..	Analyze
CO 8	**Examine** the sampling and reconstruction techniques for convertingbetween continuous time and discrete time bandlimited signals.	Analyze
CO 9	**Compute** the correlation functions and energy (power) densityspectrum for the analysis of discrete time signals/systems.	Apply
CO 10	**Apply** the correlation functions in signal detection and extractionwhen signals are corrupted with additive noise.	Apply

IV. COURSE SYLLABUS:

MODULE – I: SIGNAL ANALYSIS (12)

Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse. function, Unit Step function, Signum function.

MODULE – II: FOURIER SERIES (12)
Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet"s conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum.

Fourier Transforms:
Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms involving Impulse function and Signum function.

MODULE – III: SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS (12)
Linear System, Impulse response, Response of a Linear System, Linear Time Invariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and rise time, Convolution and Correlation of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution.

MODULE - IV LAPLACE TRANSFORM AND Z-TRANSFORM (12)
Laplace Transforms (L.T), Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis. Z–Transforms: Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.

MODULE - V SAMPLING THEOREM (12)
Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass Sampling. Correlation: Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions, Energy Density Spectrum, Parsevals Theorem, Power Density Spectrum, Relation between Autocorrelation Function and Energy/Power Spectral Density Function, Relation between Convolution and Correlation

V. TEXT BOOKS:

1. B.P. Lathi, "Signals, Systems & Communications", BSP, 2013.
2. A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, "Signals and Systems", 2nd Edition 2010.

VI. REFERENCE BOOKS:

1. Simon Haykin and Van Veen, "Signals and Systems", Wiley Publications, 2nd Edition, 2010.
2. Michel J. Robert, "Fundamentals of Signals and Systems", MGH International Edition. 2nd Edition, 2008.

VII. WEB REFERENCES:

1. https://www.edx.org/course/discrete-time-signal-processing-mitx-6-341x-1
2. https://www.mooc-list.com/course/digital-signal-processing-coursera