SIGNALS AND SYSTEMS

IV SEMESTER: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB14	Core	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Classify signals and systems and their analysis in time and frequency domains.
II. Study the concept of distortion less transmission through LTI systems, convolution and correlation properties.
III. Understand Laplace and Z-Transforms their properties for analysis of signals and systems.
IV. Identify the need for sampling of CT signals, types and merits and demerits of each type.

COURSE OUTCOMES:

CO 1: Apply the knowledge of linear algebra to represent any arbitrary signals in terms of complete sets of orthogonal functions and classify the signals and systems based on their properties.
CO 2: Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
CO 3: Understand the properties of linear time invariant system, ideal filter characteristics through distortion less transmission and its bandwidth, causality with convolution and correlation.
CO4: Apply the Laplace transform and Z- transform and their Region of convergence (ROC) properties for analysis of continuous-time and discrete-time signals and systems respectively.
CO 5: Understand the process of sampling to convert an analog signal into discrete signal and the effects of under-sampling and study correlation, spectral densities.

COURSE LEARNING OUTCOMES:

1. Apply the knowledge of vectors to find an analogy with signals.
2. Understand Orthogonal signal space and orthogonal functions.
3. Introduce the basic classification of signals in both continuous and discrete domain, exponential and sinusoidal signals, standard test signals
4. Introduce the basic classification of systems in both continuous and discrete domain
5. Representation of Fourier series for a periodic signal.
6. Deduce Fourier Transform from Fourier series.
7. Compute Fourier Transform of Periodic Signal.
8. Introduce the special transform-Hilbert transform.
9. Analyze time variance for linear systems.
10. Understand the concept of distortion less transmission through a system.
11. Analyze Causality and Paley-Wiener criterion for physical realization.
12. Understand the concept of convolution through graphical representation
13. Introduce the concepts of Laplace transform for conversion to S-domain.
14. Represent Region of Convergence for Laplace transforms and properties of Laplace Transforms.
15. Understand the Z-Transform for discrete signals with issues of Region of Convergence.
16. Analyze the properties of Z-Transforms.
17. Categorical analysis of sampling into different types.
18. Understand how to reconstruct signals after sampling.
19. Understand cross correlation and auto correlation concepts.
20. Analyze Power Spectral and Energy Spectral Characteristics.

MODULE – I	SIGNAL ANALYSIS	Classes: 08
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**	**Classes: 10**
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, Introduction to Hilbert Transforms.		
MODULE - III	**SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS**	**Classes: 10**
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**	**Classes: 08**
Laplace Transforms 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**	**Classes: 09**
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, Parseval's Theorem, Power Density Spectrum, Relation between Autocorrelation Function and Energy/Power Spectral Density Function, Relation between Convolution and Correlation, Detection of Periodic Signals in the presence of Noise by Correlation, Extraction of Signal from Noise by filtering.		

Text Books:

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

Reference Books:

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

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
E-Text Books:
1. http://onlinevideolecture.com/ebooks 2. http://www.freebookcentre.net/SpecialCat/Free-Signal-Processing-Book