IV B.Tech – I Semester
(20EE7330) ELECTRICAL SIGNAL ANALYSIS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

Pre-Requisite: Mathematics

Course Objectives

1. To understand the fundamental characteristics of signals and systems.
2. To analyse continuous time signals and systems using Fourier and Laplace transforms.
3. To Characterize LTI systems in time and frequency domain
4. To solve problems involving convolution, correlation, filtering and sampling techniques.
5. To represent discrete time signals and systems using DFS, DTFT and Z -Transform.

Syllabus

Unit – 1: Introduction

Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude-shifting, amplitude-scaling. Problems on classification and characteristics of Signals and Systems. Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function, signum function and ramp function. 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.

Unit – 2: Analysis of Continuous Time Signals and Systems

Fourier series analysis of CT Signals, CT Fourier transform (FT)- magnitude and phase spectrum, Fourier transform for standard signals, Fourier transform of arbitrary signals, Properties of Fourier transform, Inverse Fourier transform. Laplace Transform (LT)- Relation between FT & LT, pole-zero locations, Laplace transform for standard signals & it's ROC, Properties of ROC, Properties of Laplace transform, Inverse Laplace transform, causality and stability & Analysis of CT systems using Fourier transforms and Laplace Transform

Unit – 3: Analysis of Linear Systems

Linear system, Impulse response, Response of a linear system, Linear time invariant (LTI) system, Linear time variant (LTV) system, Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

Unit – 4: Correlation & Sampling Theorem

Correlation: Cross-correlation and auto-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation 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.

Sampling Theorem: 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.

Unit – 5: Analysis of Discrete Time Signals and Systems

Discrete-time Fourier Series (DFS), Discrete-time Fourier transform (DTFT) & inverse DTFT, convergence of DTFT, DTFT properties, Z-Transform (ZT) & its ROC, ROCs of right-sided, left sided and finite duration sequences, properties of ROC & ZT, inverse ZT, inversion methods-power series, PFE and Residue methods, solution of difference equations using ZT, relationship between ZT and DTFT. Application of ZT and DTFT in DT signal and system analysis, DT system function, transfer function, poles and zeros, stability

Course Outcomes

S. No	Course Outcomes	BTL
1.	Define the concepts of signals and systems using linear algebra	L1
2.	Analyse spectral characteristics of continuous-time signals using Fourier and Laplace transforms	L4
3.	Classify systems and determine the response of LTI system using convolution	L4
4.	Understand the process of sampling, the effects of under sampling and correlation	L2
5.	Apply the Z-transform and DTFT for analysing discrete-time systems	L3

Mapping of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2												3	
CO 2	3	1		1									3	
CO 3	3	1	1										3	
CO 4	3	1	1	1									3	
CO 5	2	3	1	1								1	3	

1 – Weak, 2 – Moderate and 3 - Strong

Text Books:

1. Signals, Systems & Communications – B.P. Lathi, BS Publications, 2003.
2. Signals and Systems – A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, Second Edition, 1997.
3. Signals & Systems - Simon Haykin and Van Veen, Wiley, Second Edition, 2007

Reference Books:

1. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015
2. Signals and Systems – P. Ramesh Babu and R. Ananda Natarajan, Scitech Publications, Third
3. Edition, 2004.
4. Fundamentals of Signals and Systems– Michel J. Robert, McGraw Hill, 2008.
5. Signals and Systems – T K Rawat, Oxford University Press, 2011.