III Year-I Semester		L	T	P	C
		4	0	0	3

SIGNALS & SYSTEMS (R1631023)

Prerequisite Course : Network Analysis

Course Description and Objectives: This course deals with analog and digital systems and their mathematical analysis

Course Outcome

Upon completion of the course, the student will be able to achieve the following outcomes.

Cos	Course Outcomes	POs
1	Characterize the signals and systems and principles of vector spaces, Concept of orthogonality.	3
2	Analyze the continuous-time signals and continuous-time systems using Fourier series, Fourier transform and Laplace transform	4
3	Apply sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back	4
4	Understand the relationships among the various representations of LTI systems	3
5	Understand the Concepts of convolution, correlation, Energy and Power density spectrum and their relationships	5
6	Apply z-transform to analyze discrete-time signals and systems	3

Syllabus:

UNIT I:

 Objective: To introduce the terminology of signals and systems.

 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 II:

 Objective: To introduce Fourier tools through the analogy between vectors and signals.

 FOURIER SERIES AND FOURIER TRANSFORM: Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Complex Fourier spectrum. Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Introduction to Hilbert Transform

UNIT III:

 Objective: To introduce the concept of sampling and reconstruction of signals

 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 IV:

 Objective: To analyze the linear systems in time and frequency domains.

 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. 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.

UNIT V:

Objectiv: To introduce Laplace transforms

LAPLACE TRANSFORMS : Review of Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Relation between L.T's, and F.T. of a signal. Laplace transform of certain signals using waveform synthesis.

UNIT VI:

Objective To study z-transform as mathematical tool to analyze discrete-time signals and systems

Z–TRANSFORMS : Fundamental difference between continuous-time and discrete-time signals, discrete time signal representation using complex exponential and sinusoidal components, Periodicity of discrete time using complex exponential signal, 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

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, 2nd Edn.
 3. Signals & Systems- Narayan Iyer and K Satya Prasad, Cenage Pub
REFERENCE BOOKS:
1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.
2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015
3. Signals and Systems – K Raja Rajeswari, B VisweswaraRao, PHI, 2009
4. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition, 2008.
5. Signals and Systems – T K Rawat , Oxford University press, 2011