SIGNALS AND SYSTEMS (Open elective-I)

UNIT-I: Introduction

Definition of signals and systems, classification of signals, classification of systems, operation 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, step 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: Fourier series representation of periodic signals and Fourier Transforms

Fourier series representation of continuous time periodic signals, Dirichlet's conditions, properties of Fourier series. 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 of Hilbert transform.

UNIT-III: Sampling Theorem

Graphical and analytical proof of Band limited signals, impulse sampling, Natural and Flattop sampling, Reconstruction of signals from its samples, effect of under sampling-Aliasing, Introduction to band pass sampling.

UNIT-IV: 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 functions 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 Paley-Wiener criterion for physical realization, relationship between bandwidth and rise time. Cross correlation and auto correlation of functions, properties of correlation functions, Energy density spectrum, Parseval's theorem, Power density spectrum, 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: 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: 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 signals using complex exponential signals. Concept of Z transform of a discrete sequence, Distinction between Laplace, Fourier and Z transform, Region of convergence in Z transform, constraints on ROC for various classes of signals, Inverse Z-Transform, properties of Z-transform.

Text books:

- 1. Signals, Systems & Communications- B. P. Lathi, BS Publication, 2003
- 2. Signals and Systems A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.
- 3. Signals and 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. Visweswara Rao, 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.