Nirma University

Institute:	**Institute of Technology**
Name of Programme:	**B.Tech. in Electrical Engineering**
Semester:	**V**
Course Code:	**3EE404ME26**
Course Title:	**Signals and Systems**
Course Type:	**Department Elective-I**
Year of Introduction:	**2025 – 2026**

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Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. interpret the signals in various forms for analysis (BL2)
2. analyse various signals in time domain and frequency domain systems (BL4)
3. obtain Fourier analysis of continuous time and discrete time signals (BL4)
4. apply the concept of sampling and reconstruction of signals (BL3)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction & Signal Fundamentals** Vector spaces, inner product spaces, Parseval's relations, classification: continuous-time vs discrete-time, periodic/aperiodic, energy/power, even/odd signals; elementary signals: impulse, step, exponential, sinusoids signal operations: time-shifting, scaling, time-reversal	**06**
Unit–II	**Linear Time-Invariant (LTI) systems** Response of a continuous-time LTI system, convolution, properties of continuous-time LTI systems, eigen-functions of continuous-time LTI systems, systems described by differential equations, response of a discrete-time LTI system and convolution sum, properties of discrete-time LTI systems, eigen-functions of discrete-time LTI systems, systems described by difference equations, Sampling theorem	**06**
Unit-III	**The Z-Transform and discrete-time LTI systems** The z-transform, concept of region of convergence, conversion from Laplace to z-transform, z-transforms of some common sequences, properties of the z-transform, inverse z-transform, system function of discrete-time LTI System	**06**
Unit-IV	**Fourier analysis of continuous-time signals** Fourier series representation of periodic signals, Fourier transform, properties of the continuous-time Fourier transform, frequency response of continuous-time LTI systems, introduction to FIR and IIR filters	**06**
Unit-V	**Digital Filters Structures and Design** Introduction, types of analog filter, basic types of filtering, realisation procedures for digital filters, Finite Impulse Response (FIR) filter design, Infinite Impulse Response (IIR) filter design, major considerations in designing digital filters	**07**

Unit-VI **Fourier analysis of discrete-time signals** **07**

Discrete Fourier series, Fourier transform, properties of the Fourier transform, frequency response of discrete-time LTI systems, System response to sampled continuous-time sinusoids, discrete Fourier transform, difference between DTFT and DFT, concept and algorithms of FFT

Unit-VII **Sampling and Signal Reconstructions** **07**

Introduction, sampling, sampling theorem for low pass signals, sampling techniques, impulse sampling or ideal sampling, natural sampling, flat-top sampling, reconstruction of a signal from its samples using interpolation, sampling of sinusoidal signals, sampling theorem for real-bandpass signals, sampling of discrete time signals

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/ References:

- Alan V. Oppenheim, Alan S.Willsky, S .Hamid Nawab, *Signals and Systems*, Pearson Education.
- Hwei P. Shu, *Signals and Systems*, Schaum outline, McGraw-Hill Co Ltd.
- John G. Proakis and Dimitris G. Manolakis, *Digital Signal Processing*, Principles, Algorithms and Applications, Pearson.
- M. J. Roberts, *Signals and Systems: Analysis using Transform method and MATLAB*, Tata McGraw-Hill Co Ltd.
- S. Haykin, Barry Van Veen, *Signals and Systems*, Wiley India.
- M. H. Hayes, *Digital Signal Processing, Schaum's outline series*, Tata McGraw-Hill Co Ltd.
- Ludeman L. C., *Fundamentals of Digital Signal Processing*, Wiley India.

Suggested List of Experiments: Laboratory work will be based on the above syllabus with a minimum 10 experiments to be incorporated. The students in a suitable group size will design and perform one experiment as a part of laboratory work.

Sr. No.	Name of Experiment	Hours
1.	To generate and plot continuous-time and discrete-time signals.	2
2.	To perform and visualize time-domain transformations	2
3.	To perform basic operations on signals and observe effects	2
4.	To compute linear convolution of two discrete-time signals	2
5.	To compute auto-correlation and cross-correlation	2
6.	To check linearity, time-invariance, causality, and stability	2
7.	To compute and plot Fourier series coefficients or FT	2
8.	To analyze systems using Laplace transform in MATLAB	2
9.	To calculate and plot magnitude and phase response	2
10.	To verify Nyquist criterion, aliasing effects	2
11.	To apply the Z-transform and its properties to analyze discrete-time linear time-invariant (LTI) systems	4
12.	To implement and analyze low-pass, high-pass filters	4