## DISCIPLINE SPECIFIC ELECTIVE COURSE – 1: Signal and Systems (INDSE3A)

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course (if any) |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| Signal and Systems (INDSE3A) | 04 | 03 | 0- | 01 | Course admission eligibility | Basic knowledge of mathematics |

### Learning Objectives

The Learning Objectives of this course are as follows:

- To give information about signals and systems mathematically and perform mathematical operations on signals.
- To teach the properties and the response of the LTI system using convolution.
- To give knowledge about Laplace transform, Fourier Transform and Z-transform for analysing continuous-time and discrete-time signals and systems.

### Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the basic concept and types of signals and systems and their properties which is useful to learn digital tele-communication
- Classify systems based on their properties and determine the response of LTI system using convolution
- Understand how to apply the Laplace transform, Fourier Transform and Z-transform for analyzing continuous-time and discrete-time signals and systems

### SYLLABUS OF DSE-1

**UNIT – I** **(12 hours)**

**Signals and Systems:** Continuous and discrete time signals, Transformation of the independent variable, Exponential and sinusoidal signals, Impulse and Unit step functions, Continuous-Time and Discrete-Time Systems.

**UNIT – II** **(11 hours)**

**Linear Time-Invariant Systems (LTI):** Continuous & discrete time LTI systems, Convolution Sum, Convolution integral, Properties of LTI Systems: Commutative, Distributive and Associative. LTI systems with and without memory, Invariability, Causality, Stability.Unit Step response of System, Differential and Difference equation formulation, Block diagram representation of first order systems.

**UNIT – III** **(11 hours)**

**Sampling:**The Sampling Theorem and its implications. Spectra of sampled signals.
**Laplace Transform:** Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits.

**UNIT – IV** **(11 hours)**

**Fourier Transform (FT):** Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine & Cosine transforms and their inverses.
**Z-transform:** properties, transfer function representation, inverse Z transform of rational functions- transform of input/output difference equation, stability of discrete time systems- frequency response of discrete time systems.

**Practical component:** **(30 hours)**

Learning Scilab/MATLAB (Experiments based on available systems).
Exploration of Signals and Systems using Scilab/MATLAB.

1. Generation of Signals: continuous time
2. Generation of Signals: discrete time
3. Addition, multiplication, folding and reversal of signals.
4. Convolution of Signals.
5. Solution of Difference equations.
6. Introduction to SIMULINK and calculation of output of systems represented by block diagrams.
7. Determination of Fourier Series coefficients of the given signals.
8. Determination of Fourier transform of the given signals.
9. Determination of Z transform of the given signals

**Essential/recommended readings**


1. H. P. Hsu, Signals and Systems, 4th Edition Tata McGraw Hill (2019).
2. S. T. Karris, Signal and Systems: with MATLAB Computing and Simulink Modelling, 4th EditionOrchard Publications (2008).
3. W. Y. Young, Signals and Systems with MATLAB, Springer (2014).
4. M. Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill (2010).


**Suggestive readings**


1. Alan V. Oppenheim, Alan S. Willsky with S. Hamid, Signals and Systems, 2nd edition, Pearson, Inc. (2022).


**Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**