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| **EC3503** | **Signals and Systems Analysis** | **L-T-P: 3-0-0; Total 42 Lectures** |

**Prerequisite**

Basic Mathematics.

**COURSE OBJECTIVE**

The objective of this course is to introduce undergraduate students to the fundamentals of signal and systems analysis. We encounter signals and systems extensively in our day-to-day lives, from making a phone call, listening to a song, manipulating audio files, editing photos, etc.. Each of these involves gathering, storing, transmitting and processing information from the physical world. This course will equip the students to deal with these tasks efficiently by learning the basic mathematical framework of signals and systems analysis.

**Topics Covered:**

**Unit-I: An introduction to signals and systems**: Signals and systems as seen in everyday life, and in various branches of engineering. Formalizing the common essence and requirements of signal and system analysis from these examples. Energy and power signals, signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance. Classification and Analysis of Systems (Lectures-09)

**Unit-II**: **Continuous time and discrete time Linear shift-invariant (LSI) systems**: the impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations. (Lectures-05)

**Unit-III:** **Frequency domain representations :** The notion of a frequency response and its relation to the impulse response, Dirichlet conditions for existence of frequency domain representation, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT). Parseval's Theorem. The idea of signal space and orthogonal bases of signals. (Lectures-08)

**Unit-IV:** **Laplace Transform** :The Laplace Transform for continuous time signals and systems: the notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. Generalization of Parseval's Theorem. (Lectures- 05)

 **Unit-V:** **Z Transform** :The z-Transform for discrete time signals and systems: eigen functions, region of convergence, system functions, poles and zeros of systems and sequences, z-domain analysis. Generalization of Parseval's Theorem. (Lectures-05)

**Unit-VI: Sampling :** Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems. Applications of signal and system theory for Modulation and filtering in communication engineering. ( Lectures-07)

**Unit-VII :** **System realization** : System realization through block-diagram representation and system interconnection. State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role.  **(**Lectures-03)

**Text Books**

**1.** A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.

**2.** Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.

3. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.

**Reference Books**

1. [H Hsu](https://www.amazon.in/s/ref%3Ddp_byline_sr_book_1?ie=UTF8&field-author=H+Hsu&search-alias=stripbooks) , [R Ranjan](https://www.amazon.in/s/ref%3Ddp_byline_sr_book_2?ie=UTF8&field-author=R+Ranjan&search-alias=stripbooks) , “ Signals and Systems ”, 2nd edition, Schaum’s outline series.
2. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", Tata Mc Graw Hill Edition, 2003.
3. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998
4. Tarun Kumar Rawat, Signals and Systems , oxford University press.

**COURSE OUTCOMES**

Students would be able to :

CO1: Explore the various properties of signals and system.

CO2: Deal with characterization of Linear Shift Invariant Systems, convolution and Fourier Transform, the Sampling theorem.

CO3: Understanding of Z-Transform, discrete Fourier transform and Laplace transform.

CO4: The course is useful in understanding further courses, which deal with control systems, communication systems, power systems, digital signal processing.

CO5: The concepts taught in this course are also useful to students of other disciplines like mechanical, chemical, aerospace and other branches of engineering and science.