UE20EC203: Signals and Systems (4-0-0-4-4)

Course Description:

This is one of the fundamental subjects, a thorough understanding of which is essential for proper appreciation and application of subjects like signal processing, communication and control systems. It introduces different types of signals and the basic operations performed on them. It discusses the important case of linear time invariant systems and their properties. This subject gives an insight into both continuous time and discrete time signals and systems, and their frequency domain representation.

Course Objectives:

- To familiarize different types of signals and systems typically encountered in Communication engineering
- To expose students to different transformation techniques to apply and analyze different real-life periodic and aperiodic signals to systems (typically LTI).
- To provide valuable insights of complex systems/signals analyzed through different techniques learnt
- To provide sufficient understanding of different types of signals and systems and transformation techniques for future courses in Signal Processing, Image processing and so on.

Course Outcomes:

Students completing the course should be able to

- Understand and represent signals and perform basic operations on signals.
- Determine Fourier representations for continuous-time and discrete-time signals.
- Understand LTI systems
- Analyze and design signals and systems using transformation techniques.
- Use the unilateral Z transform.
- Apply the Fourier representation properties and z- transform properties to solve problems.

Pre - Requisite: NIL

Course Content:

Unit 1: Signals and systems

Classification of signals, Continuous-time and discrete-time signals, Transformations of the independent variable, Exponential and sinusoidal signals, The unit impulse and unit step functions, Sa(x)/Sinc functions, Importance of sinc function, Continuous-time and discrete-time systems, Basic system properties.

12 Hours

Unit 2: Linear time-invariant systems

Discrete-time LTI systems: The convolution sum, Continuous-time LTI systems: The convolution integral, Properties of LTI systems, Causal LTI systems described by difference equations (Natural, Forced, and Complete Response)

10 Hours

Unit 3: Representation of Periodic (Continuous Time & Discrete-Time) Signals Using Fourier Series

Explanation of Complex Exponentials, Response of LTI systems to complex exponentials, Trigonometric Fourier Series, Fourier series representation of continuous-time periodic signals, Convergence of the Fourier series (brief discussion only), Properties of continuous-time Fourier series (CTFS), Fourier series representation of discrete-time periodic signals, Properties of Discrete-time Fourier series(DTFS)

12 Hours

Unit- 4: Continuous-time Fourier transform

(i) Representation of aperiodic signals: the continuous-time Fourier transform (CTFT), The Fourier transform for periodic signals, Properties of continuous-time Fourier transform, Fourier transform pairs; (ii) Introduction to sampling: Sampling theorem, Nyquist frequency; (iii) The discrete-time Fourier transform: Representation of aperiodic signals: the discrete-time Fourier transform (DTFT), The Fourier transform for discrete periodic signals, Properties of discrete-time Fourier transform, Fourier transform pairs, Duality**.**

12 Hours

Unit 5: Z-transformation: The Z-transform, The region of convergence (ROC) for the Ztransform, The inverse Z-transform, Properties of the Z-transform, Z-transform pairs, Analysis and characterization of LTI systems using Z-transforms. The unilateral Z-transform and solution of difference equations.

10 Hours

Text Book:

1. "Signals and Systems", V. Oppenheim and A. S. Willsky with S. H. Nawab, 2nd Edition, Pearson Education, 1996.

Reference Books:

1. "Signal Processing and Linear Systems", B. P. Lathi, 1st Indian Edition, Oxford University Press, 2006.
2. "Signals and Systems", Simon Haykin and Barry Van Veen, 2nd Edition, Wiley India, 2004.
3. "Analog and Digital Signal Processing", Ashok Ambardar, Thomas Learning, 1999.

UE20EC208: Signals and Systems Laboratory (0-0-2-1-1)

Course Objectives:

- To understand basic signal operations
- To familiarize convolution and Frequency transformation.

Course Outcomes:

Students completing the course should be able to

- Develop signal processing operations
- Examine the properties of FT
- Develop filtering operations using convolution.

Pre - Requisite: NIL

Course Content:

LIST OF EXPERIMENTS

1. Introduction to MATLAB functions.
2. Plotting discrete and continuous time signals.
3. Calculation of energy and power of signals.
4. Basic Operations of signals.
5. Impulse response and step response of LTI systems
6. Discrete and Continuous convolution
7. Solution of difference equations to find the zero input and the zeros state responses.
8. Obtaining the Fourier series of a given signal. Displaying partial sums.
9. Obtaining the Fourier Transform of a given signal and plotting its spectrum
10. Verification of properties of Fourier representations of continuous signals.
11. Obtaining the DTFT of a given signal. Verification of its properties.
12. Obtaining the impulse response and frequency response of a LTI system from its Z-Transform.

Text Book:

Manual prepared by the department.