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22EC205 SIGNALS AND SYSTEMS

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Basics of Integration, differentiation and complex numbers.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to build a grasp of the fundamental concepts of signals and systems found in engineering. The methods for characterizing and analyzing continuous-time signals and systems will be the primary focus. Students will learn transform techniques (Laplace transform and Fourier transform) that will help them understand digital communication systems, feedback control systems, satellite and mobile communications, digital signal processing, and digital image processing.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

BASICS OF CONTINUOUS TIME SIGNALS AND SYSTEMS:

Signals: Classification of continuous time signals - even/odd signals, periodic/non-periodic signals, deterministic/random signals, energy/power signals, causal/non causal signals, Standard signals - unit step, unit impulse, sinusoidal and complex exponential signals, etc., Basic operations on signals,

Systems: Representation, Classification of continuous time systems - linear/nonlinear, causal/noncausal, time invariant/time variant, with/without memory, BIBO stability, feedback system.

UNIT-2 **10L+10T+10P=30 Hours**

LTI SYSTEM AND FOURIER SERIES:

LTI system: Causality and stability of a systems, Response of LTI system, Convolution integral- properties, Continuous time LTI system described by differential equations.

Fourier series: Representation of signals using orthogonal function, Representation of continuous time periodic signals, Convergence and Properties of the Fourier series, complex Fourier spectrum.

PRACTICES:

- Plot various signals.
- Determine whether the signal is an energy or power signal.
- Tell whether the signal x(t) is symmetric, and if yes what kind of symmetry. Also, analyze x(t) in even and odd parts and confirm your result.
- Operation on signals and plot it.
- If x(t) is the applied to the system as input signal and y(t) is the output signal of the system. Determine whether the system is
  i. Linear or nonlinear,
  ii. Causal or non-causal,
  iii. Static or dynamic,
  iv. Time invariant or time variant,
  v. Stable or unstable.
- Suppose that a system is described by the impulse response h(t). Compute and plot the system response to the input signal x(t).
- Plotting the amplitude spectrum and phase spectrum (using exponential Fourier series coefficients) for the periodic signal, x(t).

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

ANALYSIS IN FREQUENCY DOMAIN:

Fourier transform: Properties of the continuous time Fourier transform, Fourier transforms of arbitrary signals, Frequency response. Laplace transform: Introduction to Laplace transform and region of convergence, Properties of the Laplace transform, Inverse Laplace transform, Analysis of LTI systems using Laplace transform, Differential equation representation and solution.

UNIT-2 **8L+8T+8P=24 Hours**

SAMPLING:

Sampling theorem, Nyquist rate, Nyquist interval, Sampling of continuous time signals, Reconstruction of signal, Aliasing.

PRACTICES:

- Compute and plot the Fourier transforms of arbitrary signals.
- Use the Fourier transform to compute (and plot) the convolution between the signals.
- Compute and plot the frequency response of a system described by the impulse response.
- Compute the unilateral Laplace of arbitrary signals.
- A system is described by the impulse response h(t). Compute the transfer function H(s) of the system.
- Sampling, Reconstruction and Analysis of signals.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the various properties and Apply transform techniques on continuous time signals and systems.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Identify the impulse response of an LTI system.	Apply	1, 2	1, 2, 5, 9, 10
3	Analyse the frequency spectrum of continuous time signals.	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Inspect sampling theorem.	Analyze	2	1, 2, 5, 9, 10, 12
5	Evaluate the properties, magnitude/phase response of various signals and systems.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Alan V. Oppenheim, Alan S. Willsky, and S. Hamid Nawab, “Signals and Systems”, 2nd edition, Pearson, 2015.
2. B.P. Lathi and Roger Green, “Linear Systems and Signals,” Oxford University Press, 3rd edition, 2020.

REFERENCE BOOKS:

1. Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd edition, Wiley, 2007.
2. Hwei P. Hsu, “Schaum’s Outline of Signals and Systems”, McGraw-Hill Education, 4th edition, 2020.
3. Luis F. Chaparro and Aydin Akan, “Signals and Systems using Matlab”, Academic Press, 3rd edition, 2019.
4. Taan S. Elali, “Continuous Signals and Systems with Matlab”, CRC Press, 3rd edition, 2021.

SKILLS:

- ✓ *Design and test a LTI system.*
- ✓ *Choose the various transforms and their applications in the analysis of signals and systems.*
- ✓ *Apply transformation to real-world problems involving bio-signals.*
- ✓ *Analyze the abnormalities present in the physiological systems.*
- ✓ *Choose the desired sampling frequency for a given application.*