ECE217: Signals and Systems

Programme:**B.Tech.(ECE&CCE)** Year:**2nd** Semester:**III**

Course: Core/Program/Open/HSS/Science/Math: **Core** Hours: **40**

CourseContextandOverview(100words):

This course introduces the fundamental ideas of signals and system analysis. Applications of these ideas include audio and image processing, communications, control, machine learning, and finance. The topics we'll cover in the course include basic properties of signals and systems, the processing of signals by linear systems, Fourier series and transforms, sampling, discrete-time processing of continuous-time signals.This course will serve as a central building block for students interested in further studying information processing in any form.

PrerequisitesCourses: Engineering Mathematics

Course Outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: Analyze the fundamental characteristics of signals and systems.
CO2: Classify Continuous-Time and Discrete-Time Linear-Time-Invariant (LTI) systems based on their properties and determine the response of the system using convolution.
CO3: Analyze the spectral characteristics of continuous-time and discrete time periodic and a periodic signals using Fourier analysis.
CO4: Analyze the continuous-time anddiscrete-time signals and systems using Laplace transform and Z-transform.
CO5:Understand sampling theorem and the effects of under sampling.

Course Topics:

Topics	**Lecture Hours**

UNIT–I **Introduction to Signals, and System**	**8**	
Definition of signals and systems; properties of signal;classification ofsignals; somespecialsignalsof importance:unitstep, unit ramp,unitimpulse, parabolic, triangular pulse, sinusoidal,exponential, the signum, the sinc, the Gaussian; basic operations on signals: time shifting, time reversal, time and amplitude scaling, signal addition and signal multiplication; propertiesof systems:causality, stability, linearity, time invariance, invertibility, static or dynamic.	8	8

UNIT-II **Continuous time and discrete time Linear Time-Invariant(LTI)systems**	**8**	8
Time domain representation and characterization of LTI systems; impulse response and step response representation; convolution; correlation; Energy spectral density(ESD), Power Spectral Density (PSD), Relation between correlation functions and spectral density; properties of LTI systems; causality and stability criteria for LTI systems; representation of systems using differential equations and difference equations.	8	
UNIT- III **Fourier Analysis**	**10**	10
Fourier representation of signals: Trigonometric and exponential Fourier series; Fourier spectrum; properties of Fourier series; application of Fourier series to LTI systems; continuous time and discrete time Fourier transform (CTFT and DTFT) and its properties; frequency response of the system using Fourier transform and its relation to impulse response; Inverse Fourier Transform, Discrete Fourier transform (DFT) and Inverse DFT with its properties.	10	
UNIT-IV **Sampling**	**6**	6
The Sampling Theorem; Nyquist rate; sampling techniques (natural, flat top, ideal); data reconstruction: ideal interpolator; zero-order hold; first-order hold, and so on; Spectrum View of Sampling and Reconstruction; Aliasing and its effects; Anti-aliasing filter; aperture effect in practical sampling.	6	
UNIT- V **Laplace Transform and Z-transform Analysis**	**10**	
Introduction to Laplace Transform; region of convergence; relation between Fourier and Laplace transform; properties of Laplace transform; inverse Laplace transform; application of Laplace transform to LTI systems; solution to differential equations and system behavior using Laplace transform; Z-transform: region of convergence; relation between Z-transform and Laplace transform; properties of Z-transform; inverse Z-transform; application of Z-transform to LTI systems.	10	10

Textbook/references (IEEE format):

TEXTBOOKS:

1. V.Oppenheim, A.S.Willsky,and S.H.Nawab, *Signals and Systems*, 2nd Ed., Prentice Hall. 2. B. P. Lathi, *Signal Processing and Linear Systems*, Oxford University Press, 2009.

REFERENCES:

1. S. Haykinand B.VanVanveen, *Signals and Systems*, 2nd Ed, Wiley, 2003.
2. M.J. Roberts, *Signals and Systems-Analysis using Transform methods and MATLAB*, Tata McGraw Hill Edition, 2003.
3. A. Nagoor Kani, *Signals and Systems*, Tata McGraw Hill.

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

1. MIT Video by Prof. Alan V. Oppenheim (http://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/)
2. http://nptel.ac.in/courses/117101055/

Evaluation Methods:

Item	Weightage (%)
Quiz	20
Assignment	05
Midterm	25
Final Examination	50

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Last Update: 28/07/2017