22EE340	SIGNALS AND SYSTEMS

Category	L	T	P	Credit
PCC	3	-	-	3

Preamble

This course deals the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals (singularity functions, complex exponentials and geometrics, Fourier representations, Laplace and Z transforms, sampling) and representations of linear, time-invariant systems (difference and differential equations, block diagrams, system functions, poles and zeros, convolution, impulse and step responses, frequency responses). Applications are drawn broadly from engineering, including feedback and control, communications, and signal processing.

Prerequisite

- NIL

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Identify the type of given signals and systems.	TPS2	70%	60%
CO2	Analyze the Time domain behaviour of a given Continuous time LTI system using Laplace Transform.	TPS4	70%	60%
CO3	Analyze the Time domain behaviour of a given Discrete Time LTI system using Z-Transform.	TPS4	70%	60%
CO4	Apply Fourier transform for frequency domain analysis of a given Continuous time LTI system	TPS3	70%	60%
CO5	Apply Fourier transform for frequency domain analysis of a given Discrete time LTI system	TPS3	70%	60%
CO6	Apply Discrete Fourier transform for frequency domain analysis of a given Discrete time LTI system	TPS3	70%	60%

*** Weightage depends on Bloom's Level, number of contact hours,

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L						M		M				M
CO2	S	M	L	L	L			M		M				S
CO3	S	M	L	L	L			M		M				S

CO4	S	M	L	L				M		M				S
CO5	S	M	L	L				M		M				S
CO6	S	M	L	L				M		M				**S**

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

CO	CAT 1			CAT 2			ASSIGNMENT 1				ASSIGNMENT 2				TERMINAL			
TPS SCALE	1	2	3	1	2	3	3	4	5	6	3	4	5	6	1	2	3	4
CO1	8	20													4	10		
CO2	8	10	20					50							4	10	8	
CO3	5	10	20					50							2		8	
CO4				8	10	15					40				4	5	8	
CO5				8	15	10					30				4	5	8	
CO6				4	15	15					30				2	10	8	

Syllabus

Introduction to Signals and Systems:

Classification of Signals and systems- Signal properties: periodicity, absolute integrability, determinism and stochastic character. Test signals: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability. Examples.

Time domain behavior of continuous and discrete time LTI systems

Impulse response and step response, convolution, correlation, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Laplace and z- Transforms

Laplace Transform for continuous time signals and systems, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Fourier Transforms

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain,

magnitude and phase response. The Discrete Time Fourier Transform (DTFT), the Discrete Fourier Transform (DFT) its properties. Parseval's Theorem, Fast Fourier Transform (FFT) - radix 2

Reference Book & Web Resources

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and Systems", Pearson India Education Services Pvt. Ltd, 2016.
2. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
3. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, nd Applications", Pearson, Fourth Edition 2006.
4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
5. https://nptel.ac.in/courses/117101055/
6. https://www.edx.org/course/signals-and-systems

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction to Signals and Systems**		
1.1	Classification of Signals and systems	2	CO1
1.2	Signal properties: periodicity, absolute integrability, determinism and stochastic character	2	CO1
1.3	Test signals: The unit step, the unit impulse, the sinusoid, the complex exponential signals	1	CO1
1.4	Time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals	1	CO1
1.5	System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability. Examples.	2	CO1
2	**Time domain behaviour of continuous and discrete time LTI systems**		
2.1	Impulse response and step response	1	CO2 &CO3
2.2	Convolution	1	CO2 &CO3
2.3	Input-output behaviour with aperiodic convergent inputs, cascade interconnections.	1	CO2 &CO3
2.4	Characterization of causality and stability of LTI systems.	1	CO2 &CO3
2.5	System representation through differential equations and difference equations	2	CO2 &CO3
2.6	Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.	2	CO4
3	**Laplace and z- Transforms**		
3.1	The Laplace Transform for continuous time signals and systems,	2	CO2
3.2	System functions, poles and zeros of system functions and signals,	2	CO2
3.3	Laplace domain analysis, solution to differential equations and system behaviour	2	CO2
3.4	The z-Transform for discrete time signals and systems	2	CO3

3.5	System functions, poles and zeros of systems and sequences, z-domain analysis	2	CO3
4	**Fourier Transform**		
4.1	Continuous Time Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients	2	CO4
4.2	Discrete Time Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients	2	CO5
4.3	Continuous Time Fourier Transform (CTFT), convolution/multiplication and their effect in the frequency domain, magnitude and phase response	2	CO4
4.4	The Discrete Time Fourier Transform (DTFT) and its properties	2	CO5
4.5	The Discrete FourierTransform (DFT) and its properties ,	2	CO6
4.6	Fast Fourier Transform - radix 2	3	CO6
4.7	Parseval's Theorem	1	CO6
	Total	40	

Course Designers:

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