

SEMESTER S4

SIGNALS AND SYSTEMS

(Common to CS/CD/CM/CA/AM/CB/CN/CU/CI)

Course Code	PECST416	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To teach the concept of a Discrete Time (DT) signal
2. To enable the learner to analyze the spectral information of any DT signal and its transformed version.
3. To provide the learner the concepts of a DT system, how it behaves to an arbitrary input, and also to analyze the behaviour of a given DT system based on z-transform

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	<p>1D Signals - A general introduction to real time signals - CT and DT signals, Sinusoids, Spectrum representation, Sampling and Aliasing (Concept only), Analog frequency and Digital frequency.</p> <p>Elementary sequences- Real Sinusoidal Sequences, Complex Exponential Sequences. - Unit impulse, step and ramp sequences, Representation of discrete time signals- (Graphical representation, Functional representation, Sequence representation)</p> <p>Properties of DT Signals - Even and Odd, Periodic and non periodic signal, Energy and Power signals. Periodicity and Symmetry property of DT signals, support of sequences, Bounded Sequences.</p> <p>Operations on Signals - Time shifting (Translation), Time Reversal (Reflection), Time scaling - Upsampling and downsampling</p> <p>DTFS - Determining the Fourier-Series Representation of a Sequence, Properties of Discrete-Time Fourier Series - Linearity, Translation (Time Shifting) , Modulation (Frequency Shifting), Reflection (Time Reversal), Conjugation, Duality, Multiplication, Parseval's Relation, Even/Odd symmetry, Real sequence.</p>	8

	(Practice of Visualization of a discrete time signal and operations on the DT signal using python. Demonstration of sampling and reconstruction using Python/Matlab.)	
2	Discrete-Time Fourier Transform for Aperiodic Sequences - Properties of the Discrete-Time Fourier Transform (Periodicity, Linearity, Translation (Time Shifting), Modulation (Frequency-Domain Shifting), Conjugation, Time Reversal, Convolution, Multiplication, Frequency-Domain Differentiation, Differencing, Parseval's theorem, Even/Odd symmetry, real sequences) DTFT of periodic sequences - Frequency Spectra of Sequences, Bandwidth of Sequences, Energy density spectra, Characterizing LTI Systems Using the Fourier Transform.	10
3	Discrete time systems - Block diagram representation and mathematical representation of discrete-time systems-Some common elements of Discrete-time systems (adder, constant multiplier, signal multiplier, unit delay, unit advance), Recursive DT systems and non recursive discrete time systems, Relaxed system, Linearity and time invariance property of a DT system. Discrete time LTI systems - Discrete time convolution, Properties of Convolution, Characterizing LTI Systems and Convolution - Impulse response of an LTI system, Difference equation, Properties of an LTI system - Causality, Memory, Invertibility, BIBO Stability, Eigen Sequences/ eigen functions for discrete-Time LTI Systems.	9
4	Z transform - motivation for z transform, Relationship Between z Transform and Discrete-Time Fourier Transform, Region of Convergence for the z Transform. Properties of z transform - Translation (Time Shifting), Complex Modulation (z-Domain Scaling), Conjugation, Time Reversal, Upsampling (Time Expansion, Downsampling, Convolution, z-Domain Differentiation, Differencing, Initial and Final Value Theorems Determination of the Inverse z Transform LTI systems and difference equations, Characterizing LTI systems using z transform, Transfer function of an LTI system. Solving Difference Equations Using the Unilateral z Transform Block Diagram Representation of Discrete-Time LTI Systems, Interconnection of LTI systems.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">• 2 Questions from each module.• Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none">• Each question carries 9 marks.• Two questions will be given from each module, out of which 1 question should be answered.• Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate the concept and different types of DT signals and the effect of different operations on the signals.	K2
CO2	Explain how DTFS can be used to represent a periodic DT signal.	K2
CO3	Apply the concept of DTFT for an aperiodic signal to determine the frequency spectrum.	K3
CO4	Utilize the properties of a DT system based on its impulse response and z transform.	K3
CO5	Identify the response of a DT LTI system to an arbitrary input sequence.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	3								3
CO3	3	3	2	2								3
CO4	3	3	3	3								3
CO5	3	3	3	3								3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Signals and Systems	Michael D. Adams	University of Victoria, British Columbia, Canada	3/e 2020
2	Signals and systems	Barry Van Veen, Simon Haykins	Wiley	2/e, 2007
3	Signals and systems	A Nagoor Khani	McGraw Hill	2/e, 2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Signals and Systems Using the Web and MATLAB	Edward W. Kamen, Bonnie S Heck	Pearson	3/e, 2014

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/courses/108/104/108104100/
2	https://archive.nptel.ac.in/courses/108/106/108106163/