25ECMJ206: Signals and Systems

w. e. f. Academic Year:	**2026-27**
Semester:	**B.E. 3rd (Electronics and Communication Engineering)**
Category of the Course:	**PCC**
Prerequisite:	Engineering Mathematics (specifically Calculus, Differential Equations, and Complex Numbers) and Basic Electrical Circuit Analysis.
Rationale:	To provide a solid mathematical foundation for analyzing continuous-time and discrete-time signals and systems which is essential for designing modern electronic and communication equipment.

Course Outcomes:

After Completion of the Course, Student will able to:

CO No.	Course Outcome (CO)	RBT Level (Cognitive Domain)
CO1	Classify and perform basic operations on signals and systems.	Understand(L2)
CO2	Evaluate the time-domain response of LTI systems using convolution.	Apply(L3)
CO3	Analyze periodic and aperiodic signals in the frequency domain.	Analyze(L4)
CO4	Analyze system stability and causality using transform techniques.	Analyze(L4)
CO5	Apply signal processing techniques to real-world applications including filtering, modulation, and communication systems.	Apply (L3)

Teaching and Evaluation Scheme:

Teaching Scheme					Examination Scheme				
L	T	P	C	Hrs/Week	IE	EE	CIA	Practical	Total Marks
3	0	2	4	5	40	60	30	20	150

IE: Internal Evaluation EE: External Exam (End Semester)
CIA: Continuous Internal Assessment Practical: Practical Exam (End Semester)

Detailed Syllabus:

Unit No.	Topic	Hrs.	Marks % Weightage (Approx.)
UNIT: 1	**Fundamentals of Signals & Systems:** **Signal Analysis:** Classification (Continuous/Discrete,	**09**	**20%**

	Periodic, Energy/Power); Basic operations; Standard signals (Step, Impulse). **System Analysis:** Linearity, Time-invariance, Causality, and Stability.		
UNIT: 2	**Time Domain Analysis (LTI Systems):** **Convolution:** Analysis of LTI systems using the Convolution Integral (CT) and Convolution Sum (DT).	**08**	**20%**
UNIT: 3	**Frequency Domain Analysis (Fourier):** **Fourier Transform:** CTFT and DTFT properties; Frequency response of LTI systems; Sampling theorem and Aliasing	**12**	**25%**
UNIT: 4	**Transform Domain Analysis (Laplace & Z):** **Transform Domain Analysis & System Realization:** Laplace Transform: ROC and S-plane analysis. Z-Transform: ROC and Unit Circle.	**08**	**20%**
UNIT: 5	**System Realization & Applications:** **System Realization: Direct Form I & II, Cascade and Parallel realizations; Applications:** Transfer function of RLC circuits; Stability analysis of feedback systems; Introduction to Filtering and Modulation basics in communication systems**.**	**08**	**15%**
		45	100%

List of Tutorial and /or Practical:

Sr No	Topic	Hrs
1	To write a program to generate and plot Unit Step, Unit Impulse, Ramp, and Exponential signals.	2
2	To generate sinusoidal signals and determine their periodicity numerically and graphically.	2
3	To implement Time Shifting, Time Scaling (up sampling/down sampling), and Time Reversal of a sequence.	2
4	To decompose a given signal into its even and odd components and verify the reconstruction.	2
5	To perform the convolution of two discrete sequences and verify the commutative property.	2
6	To compute the Auto-correlation of a signal and Cross-correlation between two different signals.	2
7	To demonstrate the Sampling Theorem and visualize the effect of under-sampling (Aliasing effect).	2
8	To check a given system for Linearity, Time-Invariance, and Causality using Scilab scripts.	2
9	To synthesize a square wave or triangular wave using the summation of its Fourier harmonics.	2
10	To compute the N-point DFT and IDFT of a sequence and plot the Magnitude and Phase spectra.	2
11	To implement circular convolution using the DFT/IDFT method and compare it with linear convolution.	2
12	To find the Z-transform of a signal and determine system stability by plotting	2

	Poles and Zeros.	
13	To analyze continuous-time systems by plotting the Pole-Zero map in the s-domain.	2
14	To find the Z-Transform of a DT sequence and visualize the ROC in relation to the Unit Circle.	2
15	To find and plot the Magnitude and Phase response of a system given its differential equation.	2
	Total Hours	**30**

Learning Resources:

1. Text Books:

1. Oppenheim A. V. & Schafer R. W., Signals and Systems, Pearson Education
2. Proakis J. G. & Manolakis D. G., Digital Signal Processing, Principles, algorithms & applications, Pearson Education.
3. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
4. Signals and Systems by Tarun Rawat Pub: Oxford

2. Reference Books:

1. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
2. Simon Haykin & Barry Van Veen, Signals and Systems, Wiley-India.
3. D. Ganesh Rao & Satish Tunga, Signals and Systems, Sanguine Technical Publishers
4. Roy Choudhury, Networks & Systems, New Age International publishers
5. S. Palani , Signals and Systems, Ane Books Pvt. Ltd

Teaching Learning Method:

- Lecture-based teaching-learning.
- Learning through problem-solving.
- Technology-based Learning.
- Kinesthetic learning / Practicals.
- Individual learning/self-study.
- Group-teaching and learning.
- Peer Teaching.
- Expeditionary learning (Real-world problems).

Course Outcomes Mapping:

CO No.	Course Outcome (CO)	POs/ PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Class Sessions (Lecture)
CO1	Classify and perform basic operations on signals and systems.	PO1, PO2, PSO1	Understand (L2)	Conceptual	09
CO2	Evaluate the time-domain response of LTI systems using convolution.	PO1, PO2, PO4, PSO1	Apply (L3)	Procedural	08

CO3	Analyze periodic and aperiodic signals in the frequency domain.	PO1, PO2, PO3, PSO1	Analyze (L4)	Procedural	12
CO4	Analyze system stability and causality using transform techniques.	PO1, PO2, PO4, PSO1	Analyze (L4)	Conceptual / Procedural	08
CO5	Apply signal processing techniques to real-world applications including filtering, modulation, and communication systems.	PO1, PO3, PO5, PSO2	Apply (L3)	Procedural	08

Mapping of COs with POs & PSOs:

CO	PO											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3	0	0	0	0	0	0	0	0	0	3	0
CO2	3	3	0	2	0	0	0	0	0	0	0	3	0
CO3	3	3	2	0	0	0	0	0	0	0	0	3	0
CO4	3	3	0	2	0	0	0	0	0	0	0	3	0
CO5	3	0	2	0	1	0	0	0	0	0	0	0	1

3: High, 2: Medium, 1: Low

Sustainable Development Goals (SDG) Integration:

The course on Signals and Systems supports **SDG 4 (Quality Education)** by strengthening analytical and problem-solving skills in signal analysis. It contributes to **SDG 9 (Industry, Innovation and Infrastructure)** through the design and analysis of efficient communication and electronic systems. The application of signal processing in real-world domains like filtering and modulation also aligns with **SDG 11 (Sustainable Cities and Communities)** by enabling smart and reliable communication technologies. Additionally, it has relevance to **SDG 7 (Affordable and Clean Energy)** through its role in modern energy monitoring and smart grid systems.

SDG Mapping with Course Outcomes:

CO	Course Outcome	Relevant SDGs	Justification
CO1	Classify and perform basic operations on signals and systems.	SDG 4	Builds strong foundational knowledge in signal analysis, supporting technical education and lifelong learning in engineering

			disciplines.
CO2	Evaluate the time-domain response of LTI systems using convolution.	SDG 9	Enables understanding of system behavior essential for designing reliable electronic and communication infrastructure systems.
CO3	Analyze periodic and aperiodic signals in the frequency domain.	SDG 9	Supports innovation in signal processing applications such as telecommunications, audio processing, and spectrum analysis.
CO4	Analyze system stability and causality using transform techniques.	SDG 9	Ensures development of stable and efficient systems used in critical infrastructure like control systems, communication networks, and automation.
CO5	Apply signal processing techniques to real-world applications including filtering, modulation, and communication systems.	SDG 9, SDG 11	Contributes to development of smart communication systems, efficient signal transmission, and technologies used in smart cities (e.g., wireless networks, IoT systems).