SIGNALS AND SYSTEMS
SEMESTER – IV (EC/TC)
[As per Choice Based Credit System (CBCS) Scheme]

Course Code	17EC42	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:
- Understand the mathematical description of continuous and discrete time signals and systems.
- Analyze the signals in time domain using convolution difference/differential equations
- Classify signals into different categories based on their properties.
- Analyze Linear Time Invariant (LTI) systems in time and transform domains.
- Build basics for understanding of courses such as signal processing, control system and communication.

Module -1

Introduction and Classification of signals: Definition of signal and systems, communication and control systems as examples. Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power.
Elementary signals/Functions: Exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sync functions.
Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding.
Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non- causal, static and dynamic, stable and unstable, invertible. **L1, L2, L3**

Module -2

Time domain representation of LTI System: System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral and convolution sum using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Properties of convolution.
L1, L2, L3

Module -3

System interconnection, system properties in terms of impulse response, step response in terms of impulse response (4 Hours).

Fourier Representation of Periodic Signals: Introduction to CTFS and DTFS, definition, properties (No derivation) and basic problems (inverse Fourier series is excluded) (06 Hours). **L1, L2, L3**

Module -4

Fourier Representation of aperiodic Signals: **FT representation of aperiodic CT signals - FT,** definition, FT of standard CT signals, Properties and their significance (4 Hours).   **FT representation of aperiodic discrete signals-DTFT,** definition, DTFT of standard discrete signals, Properties and their significance (4 Hours).   **Impulse sampling and reconstruction:** Sampling theorem (only statement) and reconstruction of signals (2 Hours). **L1, L2, L3**

Module -5
Z-Transforms: Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform, Transform analysis of LTI systems. **L1, L2, L3**

Course Outcomes: At the end of the course, students will be able to:
- Classify the signals as continuous/discrete, periodic/aperiodic, even/odd, energy/power and deterministic/random signals.   - Determine the linearity, causality, time-invariance and stability properties of continuous and discrete time systems.   - Compute the response of a Continuous and Discrete LTI system using convolution integral and convolution sum.   - Determine the spectral characteristics of continuous and discrete time signal using Fourier analysis.   - Compute Z-transforms, inverse Z- transforms and transfer functions of complex LTI systems.

Text Book:
Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, WileyIndia. ISBN 9971-51-239-4.

Reference Books:
1. **Michael Roberts,** "Fundamentals of Signals & Systems", 2nd edition, Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.   2. **Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab,** "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002.   3. **H. P Hsu, R. Ranjan,** "Signals and Systems", Scham's outlines, TMH, 2006.   4. **B. P. Lathi,** "Linear Systems and Signals", Oxford University Press, 2005.   5. **Ganesh Rao and Satish Tunga,** "Signals and Systems", Pearson/Sanguine Technical Publishers, 2004.

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