2EL01: SIGNALS AND SYSTEMS
CREDITS - 3 (LTP:3,0,0)

Course Objective:

1. The goal of this course is to introduce basic principles of signals and systems and establish the fundamentals of signals and system applications as required for electronics and communication engineering students.
2. The course aims to make the student familiar with principles of signals and systems like various transformations, time-frequency characterization, sampling process for analog and digital application, etc.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory		Practical		
L	T	P	C	ESE	CE	ESE	CE	
3	0	0	3	60	40	00	00	100

Course Contents:

Unit No.	Topics	Teaching Hours
1	Energy and power signals, periodic and aperiodic signals, continuous and discrete time signals, continuous and discrete amplitude signals. Some useful signals: unit impulse, unit step, unit ramp, square pulse, exponential sinusoidal, real sinusoidal and their parameters. Some useful signal operations: Shift in time, Scaling in time, inner product, convolution, correlation. (ACF & CCF). The idea of signal space and orthogonal bases.	09
2	Linear shift-invariant (LSI) systems impulse response and step response, convolution, input output behaviour with aperiodic convergent inputs. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations.	09
3	Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.	06
4	The Laplace Transform, notion of Eigen functions of LSI systems, a basis of Eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behaviour.	06
5	The z-Transform for discrete time signals and systems- Eigen functions, region of convergence z-domain analysis.	06
6	The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.	09

Unit No.	Topics	Teaching Hours
	Total	**45**

List of References:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, *"Signals and Systems"*, Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, *"Signals and Systems - Continuous and Discrete"*, 4th edition, Prentice Hall, 1998.
3. Papoulis, *"Circuits and Systems: A Modern Approach"*, HRW, 1980.
4. B.P. Lathi, "*Signal Processing and Linear Systems"*, Oxford University Press, c1998.
5. Douglas K. Lindner, "*Introduction to Signals and Systems"*, McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, *"Signals and Systems*", John Wiley and Sons (Asia) Private Limited, c1998.
7. Robert A. Gabel, Richard A. Roberts, *"Signals and Linear Systems"*, John Wiley and Sons, 1995.
8. M. J. Roberts, *"Signals and Systems - Analysis using Transform methods and MATLAB"*, TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, *"Signals and Systems*", TMH New Delhi, 2001.
10. Ashok Ambardar,*"Analog and Digital Signal Processing*", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

Course Outcomes (COs):

At the end of this course students will demonstrate the ability to

1. Analyze different types of signals and perform various signal operations.
2. Investigate whether the system is LSI, causal and stable.
3. Represent continuous and discrete LSI systems in time and frequency domain using different transforms.
4. Sampling and reconstruction of a signal