Course Syllabi: UEI303 Techniques on Signal and Systems (L : T : P :: 3 : 1 : 0)

1. **Course number and name:** UEI303; Techniques on Signal and Systems

2. **Credits and contact hours:** Credits: 3.5; Hours: 4

3. **Text book, title, author, and year**

   - *Oppenheim, A.V. and Willsky, A.S., Signals and Systems, Prentice Hall of India (1997) 2nd ed.*
   - *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall (2007) 4th ed.*
   - *Lathi, B.P., Signal Processing and Linear System, Oxford University Press (2008).*
   - *Roberts, M.J., Fundamentals of Signals and Systems, McGraw Hill (2007).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Introduction: Signals and Systems, Classification of signals, Continuous time signals and its classifications, Standard continuous time signals, Classification of continuous time systems, Discrete time signals and its classifications, Concept of frequency in discrete time signals, Standard discrete time signals, Discrete time systems, Classification of discrete time systems, Nyquist rate, Sampling theorem, Aliasing, Convolution, Correlation.

   Fourier Series: Introduction, Dirichlet Conditions, Determination of Fourier Coefficients, Wave symmetry, Exponential form of Fourier Series.

   Fourier Transform: Introduction, Condition for existence of Fourier Integral, Fourier Transform of Gate function, Impulse Function, Shifted impulse function, One-sided exponential function, Two-sided exponential function, $\sin(t)e^{-a(t)}$, Signum function, f(t) = 1 and unit step functions; Properties of Fourier Transform: Linearity, Time Scaling, Time Differentiation, Time Shifting Property, Translation in the frequency domain, Modulation theorem, Symmetry or duality property, Time convolution property, Frequency convolution, Frequency differentiation, Time integration, Fourier transform of f(-t) and Symmetry properties of Fourier Transform; Energy density and Power Spectral Density, Nyquist Theorem, System Analysis using Fourier Transform.

   Laplace Transform: Introduction, Region of Convergence (ROC), Inverse Laplace Transform, Properties of Lapalce Transform, Laplace transform of a derivative $\frac{df(t)}{dt}$, Laplace transform of an integral $\int f(t)dt$, Laplace transform of unit step function, Impulse function, Ramp function, Parabolic function, $f(t) = e^{at}u(t)$, $f(t) = e^{-at}u(t)$, Sinusoidal function, Cosine function, Hyperbolic sine and cosine functions, Damped sine and cosine functions, Damped hyperbolic sine and cosine functions, t^n. Laplace transform of two sided functions and their ROCs, Initial value theorem and final value theorem, Partial fraction Expansions.

   z-Transform: Introduction, Region of Convergence (ROC), Properties of z-transform: Linearity, Time shifting, Scaling in z-domain, Time reversal, Differentiation in z-domain, Convolution in z-domain, Correlation of two sequences, Multiplication of two sequences, Conjugate of complex sequence, Real part of a sequence, Imaginary part of a sequence. Initial value theorem, Final Value theorem, Partial Sum, Parseval's Theorem, z-transform of standard

sequences, Inverse z-transform, Pole-Zero plot, System function of LTI system, Causality and Stability in terms of z-transform.

Random Signals: Introduction, Probability, Random variables, Gaussian distribution, Transformation of random variables, random processes, stationary processes, Correlation and Covariance Functions, Regularity and Ergodicity, Gaussian Process.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:

   - Explain the basics of signals and systems.
   - Solve different type of problems related to Fourier series and Fourier transforms.
   - Use Laplace transforms and Fourier transforms for different applications.
   - Describe the concept of random signals.

6. **Brief list of topics to be covered**

   - Basics of signals and systems
   - Fourier Series
   - Fourier Transform
   - Laplace Transform
   - Z- Transform
   - Random Signals