MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by NAAC with 'A' Grade & Recognized Under Section 2(f) & 12(B) of the UGC act,1956

COURSE CONTENT

MODELLING AND SIMULATION LABORATORY							
III Semester: ECE							
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**	
2530472	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 32**				**Total Classes: 32**	
Prerequisites: knowledge on modelling and simulation							

Couse Overview:

This comprehensive set of experiments offers hands-on exposure to signal processing, systems analysis, probability theory, stochastic processes, and control systems. Students will generate and manipulate standard and nonstandard signals, analyze system behaviors through transforms and correlation techniques, and explore real-world applications such as noise reduction, waveform synthesis, and PID control. Additionally, practical simulations using Simulink and Python equip students with critical skills in modeling, analysis, and system design.

Course Objectives:

The students will try to learn

- Generation and manipulation of standard and nonstandard continuous/discrete-time signals
- Analytical skills for understanding system properties, convolution and transform techniques.
- The Fourier, Laplace, and Z-Transform methods for spectral analysis, waveform synthesis, and pole-zero analysis in time and frequency domains.
- Concepts of stochastic processes and probability theory, including random variable generation.
- Modeling and simulation of control systems using Simulink, including solving differential equations, analyzing RLC circuits, and implementing PID controllers.

Course Outcomes:

After successful completion of the course, students shall be able to

- Generate various standard and nonstandard signals, analyze their properties, and perform signal operations and synthesis in both time and frequency domains
- Capable of evaluating system responses using convolution, testing system characteristics like linearity and time-invariance, and analyzing LTI systems through impulse and sinusoidal inputs.
- Perform spectral analysis using Fourier, Laplace, and Z-transforms, and interpret magnitude-phase spectra and pole-zero plots in s- and z-domains.
- Demonstrate the ability to simulate random processes, analyze statistical properties of Gaussian noise, and apply correlation techniques for noise removal and signal extraction.
- Proficient in modeling and simulating dynamic systems in Simulink, including RLC circuit behavior and PID control, as well as assessing controllability and observability of systems.

Note: All the experiments are to be simulated using MATLAB or equivalent software. Minimum of 12 experiments are to be completed / simulated.

List of Experiments:

1. Write the code / script for generating various standard viz: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw-tooth, Triangular, Sinusoidal, Ramp, Sinc and Nonstandard Signals and Sequences generated from these standard signals /sequences using Waveform synthesis. Also, for perform different operations viz: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power on them.
2. Write the code / script for finding the Even and Odd parts of Signal / Sequence and Real and Imaginary parts of Signal.
3. Write the code / script for finding the output of a System for a given input and Impulse Response and finding Auto Correlation and Cross Correlation of Signals / sequences
4. Write the code / script for Verifying whether a given Continuous/Discrete System is Linear, Time Invariant, Stable and Physically Realizable
5. Write the code / script for obtaining Sinusoidal response and Impulse response of a given Continuous / Discrete LTI System.
   a) Plot the Real and Imaginary part and
   b) Magnitude and Phase Plot of the response
6. Write the code / script for finding and plotting the Magnitude and Phase Spectrum of any given Signal by finding its Fourier Transform by using the properties where ever required.
7. Write the code / script for finding and plotting the Magnitude and Phase Spectrum of any given Signal by finding its Laplace Transform by using the properties where ever required. Also plot pole-zero diagram in S-plane
8. Write the code/ script for finding and plotting the Magnitude and Phase Spectrum of any given Sequence by finding its Z-Transform by using the properties wherever required. Also plot pole – zero diagram in Z-plane
9. Design a Simulink or equivalent model for
   a) Solving Differential Equations
   b) Finding the response of any RLC Circuit with different initial Conditions for AC and DC inputs and plot the corresponding responses
10. Gibbs Phenomenon and waveform synthesis

Probability Theory and Stochastic Processes (Minimum 3 Experiments)
11. Write the code / script for generating various Random Variables with different CDFs/ PDFs
12. Write the code / script for generating Gaussian noise and for finding its mean, Skewness, Kurtosis, PDF and PSD.
13. Write the code / script for Verifying Sampling theorem for different sampling rates, Sampling types and Duty Cycles and for plotting the sampled and reconstructed Signals.
14. Write the code / script for Removal of noise from the signal using Cross correlation.
15. Write the code / script for Extraction of Periodic Signal masked by noise using Auto
16. Correlation

Control Systems (Minimum 2 Experiments)
17. Build and Simulate a DC Motor using Simulink
18. Implementation of a PID Controller from equations using Simulink
19. Controllability and Observability

Note: For the experiments with code/scripts written in MATLAB or equivalent (1-8, 11-15), the student can design a user interface or app using MATLAB App Designer or equivalent.

REFERENCE LINK:

1. https://www.youtube.com/watch?v=8Wwp4F4sqlQ&list=PLGcAKoJcko8wNdcmGwhf0rObttsnGs_HC
2. https://www.youtube.com/watch?v=1RZjoGH6R2U&list=PLGcAKoJcko8wNdcmGwhf0rObttsnGs_HC&index2
3. https://www.youtube.com/watch?v=HDg9sHxqAvo&list=PLGcAKoJcko8wNdcmGwhf0rObttsnGs_HC&index3
4. https://www.youtube.com/watch?v=CkGfHet7KA&list=PLGcAKoJcko8wNdcmGwhf0rObttsnGs_HC&index=4
5. https://www.youtube.com/watch?v=kDDz5rTC-bs&list=PLGcAKoJcko8wNdcmGwhf0rObttsnGs_HC&index=5

MATERIALS ONLINE:

1. Lab Manual
2. Open-ended experiments