COURSE CONTENT

CONTROL SYSTEMS LAB								
II Semester: EEE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
2540281	**Core**	0	0	2	1	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes:30**		
Co requisites: **Control Systems**								

Course Overview:

This laboratory course focuses on the modeling, analysis, and control of dynamic systems using experimental and simulation-based methods. It covers time response analysis, transfer function determination, stability analysis of LTI systems, characteristics of servo motors and synchros, and controller design using lead–lag and PID techniques. Digital simulation tools and basic PLC applications are used to analyze system behavior and control performance.

Course Objectives:

1. To understand the dynamic behavior of first- and second-order systems using time-domain analysis and experimental observations.
2. To study and analyze the characteristics of DC and AC servo motors, DC generators, and synchros for practical control applications.
3. To design, implement, and analyze classical controllers (P, PI, PD, PID) and compensators (lead, lag, lead-lag) using experimental and simulation techniques.
4. To perform stability analysis of linear time-invariant systems using frequency-domain and simulation tools (Bode, Root Locus, Nyquist).
5. To model systems in state-space form, analyze multi-variable system behavior, and apply programmable logic controllers for simple control applications.

Course Outcomes: After Completion of the Course, Students should be able to

1. Analyze time response of first- and second-order systems and interpret transient and steady-state behavior.
2. Evaluate characteristics of DC/AC servo motors, DC generators, and synchros for control and instrumentation applications.
3. Design classical controllers (P, PI, PD, PID) and compensators (lead, lag, lead-lag) for improved system performance.
4. Assess system stability using Bode plots, Root Locus, and Nyquist criteria through simulation tools.
5. Model systems in state-space form and implement basic logic control using programmable logic controllers (PLC).

The following experiments are required to be conducted compulsory experiments:

1. Time response of Second order system
2. Characteristics of Synchro's
3. Characteristics of AC servo motor
4. Transfer function of DC motor
5. Transfer function of DC generator
6. Lag and lead compensation – Magnitude and phase plot
7. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using digital

simulation.

8. State space model for classical transfer function using digital simulation.

In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted

1. Effect of feedback on DC servo motor
1. Temperature controller using PID
2. Effect of P, PD, PI, PID Controller on a second order systems
3. (a) Simulation of P, PI, PID Controller.
   (b) Linear system analysis (Time domain analysis, Error analysis) using suitable software
4. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions, and application of speed control of motor.
5. Design of Lead-Lag compensator for the given system and with specification using suitable software

Proposed open ended experiments:

1. Lead-Lag Compensator Design for EV Motor Drive using digital simulation.

TEXT BOOKS:

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.

REFERENCE BOOKS:

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
2. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.

ELECTRONIC RESOURCES:

1. **https://nptel.ac.in/**
2. **https://www.mathworks.com/help**
3. **https://www.allaboutcircuits.com/**
4. **https://ocw.mit.edu/**
5. **https://www.siemens.com/**

MATERIALS ONLINE:

1. Lab Manual
1. Open-ended experiments