CONTROL SYSTEMS LABORATORY

IV Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
AEEB18	Core	-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 42				Total Classes: 42		

OBJECTIVES:

The course should enable the students to:

I. Understand mathematical models of electrical and mechanical systems
II. Analysis of control system stability using digital simulation.
III. Demonstrate the time domain and frequency domain analysis for linear time invariant systems.
IV. Apply programmable logic controllers to demonstrate industrial controls in the laboratory

COURSE OUTCOMES (COs):

CO 1: Understand the transfer functions and state space modle using simulation .
CO 2: Draw the Frequency response plots like Bode, Nyquist and Polar plots (magnitude and phase) for a given transfer function
CO 3: Develop a PLC program for an automatic control system of a medium degree of complexity and select the right hardware for a given application
CO 4: Analyse a compensator in the frequency domain to meet specific design requirements using a lead compensator, lag compensator, or lead-lag compensator
CO 5: Develop a PLC program for an automatic control system of a medium degree of complexity and select the right hardware for a given application

COURSE LEARNING OUTCOMES (CLOs)

At the end of the course, the student will have the ability to:

1. Demonstrate the response of first order and second order systems with various standard test signals
2. Understand the concept of time domain analysis of series RLC Circuit.
3. Identify the transfer function and analyze the time response of DC motor.
4. Examine the speed torque characteristics of AC Servomotor.
5. Estimate the error obtained in control system with the effect of P, PI, PID controllers
6. Design of lead, lag, lag-lead compensator to improve characteristics of control system
7. Record the dynamic behavior of temperature control system with P, PI, PID controllers.
8. Construct the PID controller using Op-Amps and verify using MATLAB
9. Analyze the stability of time invariant control system using root locus, bode plot, polar plot, nyquist criterions.
10. Calculate the transfer function from state space model and state space model from transfer function using MATLAB
11. Implementation of Ladder diagram, Truth Tables, Counter, Blinking of lights, Control of Water level using PLC

12. Implement ladder diagrams for blinking of lights ,control of water level using PLC	
LIST OF EXPERIMENTS	
Week-1	**TIME RESPONSE OF SECOND ORDER SYSTEM**
To obtain the time response of a given second order system with time domain specifications.	
Week-2	**TRANSFER FUNCTION OF DC MOTOR**
Determine the transfer function, time response of DC motor and verification with digital simulation.	
Week-3	**AC SERVO MOTOR**
Study of AC servomotor and plot its torque speed characteristics.	
Week-4	**EFFECT OF VARIOUS CONTROLLERS ON SECOND ORDER SYSTEM**
Study the effect of P, PD, PI and PID controller on closed loop second order systems**.**	
Week-5	**COMPENSATOR**
Study lead-lag compensator and obtain its magnitude, phase plots.	
Week-6	**TEMPERATURE CONTROLLER**
Study the performance of PID controller used to control the temperature of an oven.	
Week-7	**DESIGN AND VERIFICATION OF OP-AMP BASED PID CONTROLLER**
Implementation of op-amp based PID Controller and verification using MATLAB	
Week-8	**STABILITY ANALYSIS USING DIGITAL SIMULATION**
Stability analysis using root locus, Bode plot, Polar, Nyquist criterions of linear time invariant system by digital simulation.	
Week-9	**STATE SPACE MODEL USING DIGITAL SIMULATION**
Verification of state space model from transfer function and transfer function from state space model using digital simulation.	
Week-10	**LADDER DIAGRAMS USING PLC**
Input output connection, simple programming, ladder diagrams, uploading, running the program and debugging in programmable logic controller.	
Week-11	**TRUTH TABLES USING PLC**
Study and verification of truth tables of logic gates, simple boolean expressions and application to speed control of DC motor using programmable logic controller.	
Week-12	**IMPLEMENTATION OF COUNTER**
Implementation of counting number of objects and taking action using PLC.	
Week-13	**BLINKING LIGHTS USING PLC**
Implementation of blinking lights with programmable logic controller.	
Week-14	**WATER LEVEL CONTROL**
Control of maximum and minimum level of water in a tank using PLC.	
Text Books:	
1. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons, Inc., 6th Edition, 2004. 2. J Nagrath, M Gopal, "Control Systems Engineering", New Age International, 3rd Edition, 2007. 3. John W. webb, Ronald A.Reis, "Programmable Logic Controllers, Principles and Applications",5th Edition,	

2002

4. A Nagoor Kani, “Control Systems”, RBA Publications,1st Edition, 2009

Reference Books:

1. Benjamin Kuo, “Automatic Control Systems”, PHI, 7th Edition, 1987
2. K Ogata, “Modern Control Engineering”, Prentice Hall, 4th Edition, 2003.

Web References:

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in