

## CONTROL SYSTEMS AND SIMULATION LAB

IV Semester: EEE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEE115	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
<b>Contact Classes: Nil</b>	<b>Tutorial Classes: Nil</b>	<b>Practical Classes: 45</b>			<b>Total Classes: 45</b>			
<p><b>OBJECTIVES:</b>            The course should enable the students to:</p> <ol style="list-style-type: none"> <li>Understand mathematical models of electrical and mechanical systems.</li> <li>Analysis of control system stability using digital simulation.</li> <li>Demonstrate the time domain and frequency domain analysis for linear time invariant systems.</li> <li>Apply programmable logic controllers to demonstrate industrial controls in the laboratory.</li> </ol> <p><b>COURSE LEARNING OUTCOMES (CLOs):</b>            The students should enable to:</p> <ol style="list-style-type: none"> <li>Demonstrate the response of first order and second order systems with various standard test signals.</li> <li>Understand the concept of time domain analysis of series RLC Circuit.</li> <li>Identify the transfer function and analyze the time response of DC motor.</li> <li>Examine the speed torque characteristics of AC Servomotor.</li> <li>Estimate the error obtained in control system with the effect of P, PI, PID controllers.</li> <li>Design of lead, lag, lag-lead compensator to improve characteristics of control system.</li> <li>Record the dynamic behaviour of temperature control system with P, PI, PID controllers.</li> <li>Construct the PID controller using Op-Amps and verify using MATLAB.</li> <li>Analyze the stability of time invariant control system using root locus, bode plot, polar plot, nyquist criterions.</li> <li>Calculate the transfer function from state space model and state space model from transfer function using MATLAB.</li> <li>Implement ladder diagrams, truth tables, counter, using programmable logic controller.</li> <li>Implement ladder diagrams of blinking of lights ,control of water level using programmable logic controller.</li> </ol>								
<b>LIST OF EXPERIMENTS</b>								
<b>Week-1</b>	<b>TIME RESPONSE OF SECOND ORDER SYSTEM</b>							
To obtain the time response of a given second order system with time domain specifications.								
<b>Week-2</b>	<b>TRANSFER FUNCTION OF DC MOTOR</b>							
Determine the transfer function, time response of DC motor and verification with digital simulation.								
<b>Week-3</b>	<b>AC SERVO MOTOR</b>							
Study of AC servomotor and plot its torque speed characteristics.								
<b>Week-4</b>	<b>EFFECT OF VARIOUS CONTROLLERS ON SECOND ORDER SYSTEM</b>							
Study the effect of P, PD, PI and PID controller on closed loop second order systems.								

<b>Week-5</b>	<b>COMPENSATOR</b>
Study lead-lag compensator and obtain its magnitude, phase plots.	
<b>Week-6</b>	<b>TEMPERATURE CONTROLLER</b>
Study the performance of PID controller used to control the temperature of an oven.	
<b>Week-7</b>	<b>DESIGN AND VERIFICATION OF OP-AMP BASED PID CONTROLLER</b>
Implementation of op-amp based PID Controller and verification using MATLAB	
<b>Week-8</b>	<b>STABILITY ANALYSIS USING DIGITAL SIMULATION</b>
Stability analysis using root locus, Bode plot, Polar, Nyquist criterions of linear time invariant system by digital simulation.	
<b>Week-9</b>	<b>STATE SPACE MODEL USING DIGITAL SIMULATION</b>
Verification of state space model from transfer function and transfer function from state space model using digital simulation.	
<b>Week-10</b>	<b>LADDER DIAGRAMS USING PLC</b>
Input output connection, simple programming, ladder diagrams, uploading, running the program and debugging in programmable logic controller.	
<b>Week-11</b>	<b>TRUTH TABLES USING PLC</b>
Study and verification of truth tables of logic gates, simple boolean expressions and application to speed control of DC motor using programmable logic controller.	
<b>Week-12</b>	<b>IMPLEMENTATION OF COUNTER</b>
Implementation of counting number of objects and taking action using PLC.	
<b>Week-13</b>	<b>BLINKING LIGHTS USING PLC</b>
Implementation of blinking lights with programmable logic controller.	
<b>Week-14</b>	<b>WATER LEVEL CONTROL</b>
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., 6 <sup>th</sup> Edition.
2	J Nagrath, M Gopal, "Control Systems Engineering", New Age International, 3 <sup>rd</sup> Edition, 2007.
3	John W. webb, Ronald A.Reis, "Programmable Logic Controllers,Principles and Applications",5 <sup>th</sup> Edition,2002.
4	A.Nagoor Kani, "Control Systems ",RBA Publications,1 <sup>st</sup> Edition

### References:

1	Benjamin Kuo, "Automatic Control Systems", PHI, 7 <sup>th</sup> Edition, 1987.
2	K Ogata, "Modern Control Engineering", Prentice Hall, 4 <sup>th</sup> Edition, 2003.