

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	Control Theory
Course Code:	1ET1090404
Pre-requisite Course:	Differential equations and its solution, Fundamental of circuit analysis, Laplace transform, Matrix analysis.

Course Objectives:

1. To Understand fundamental of different types of feedback control system.
2. To design and develop mathematical model of dynamic systems with desired behaviors.
3. To learn the basics of stability analysis of the system.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)								
Lecture	Tutorial	Practical	Credit	Theory				Practical				Total
				University Assessment		Continuous Assessment		University Assessment		Continuous Assessment		
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	-	2	4	28	70	12	30	12	30	08	20	150

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	Introduction to Control Systems: Introduction, Brief History of Automatic Control system, Different terminology like plant, process, system, disturbances, controlled variable, manipulated variable etc., Classifications of control systems, open loop versus closed loop control systems, It's Block diagram and application areas with examples.	04	08
2	Mathematical Modeling of systems: Introduction, Transfer Function, Modelling of Electrical and Mechanical system, Force voltage and Force current analogy, Transfer Function of armature controlled, field controlled DC Motor and Gear Train, Block Diagram reduction technique, Signal-Flow Graph using Mason's Gain formula.	12	25
3	Steady-State and Transient Response Analysis: Introduction, Type and Order of System, Standard Test Signals, Time Responses of first and second order control system under different test input, Steady-State Errors for first and second order systems, Transient Response Analysis with MATLAB, Performance indices, Basic of Proportional, PI, PID controllers, Limitations of time domain analysis.	06	18

4	The Stability of Linear Feedback Systems: Concept of stability, types of stability, The Routh-Hurwitz Stability Criterion, special cases with numerical examples. The Relative Stability of Feedback Control Systems.	05	14
5	Root-Locus Analysis: Introduction, Root-Locus Plots, General Rules for Constructing Root Loci.	06	15
6	Stability in the Frequency Domain: Introduction, Frequency Response Plots, Frequency Response Measurements, Performance Specifications in the Frequency Domain, Bode Diagrams, Polar Plots, Nyquist Stability Criterion.	10	20

Text Books:

1. Modern control theory", Katseuhiko Ogata, Pearson Education International, Fifth edition.
2. Linear Control System", B.S.Manke, Khanna Publishers.
3. Control system engineering", Norman S Nise, John Wiley & Sons, Inc., Sixth edition.

Reference Books:

1. Modern control systems", Richard C. Dorf, Robert H Bishop, Pearson Education International, Twelfth edition.
2. Control System Engineering", J.Nagrath and M.Gopal, New Age International Publishers, 5th Edition, 2007.

List of Experiments:

1. Introduction to Matlab software.
2. To find Unit step, ramp, impulse response of first and second order system using Matlab.
3. To derive the open loop and closed loop poles and zeros for varieties of the systems. Draw their Pole-zero map and check the system stability.
4. To draw the step response of overdamped, under damped and critically damped system for the second order system having different value of damping factor.
5. To find out time domain specification of second order system using Matlab.
6. To obtain state space presentation of a system using MATLAB programming.
7. To plot root locus for a given system using Matlab. To derive the value of gain from Root Locus for system marginal stability.
8. To draw Bode plot for a given system using Matlab. Derive GM, PM and stability from the plot.
9. To draw Nyquist plot for a given system using Matlab.
10. To draw Polar plot for a given system using Matlab.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Model electric, mechanical and electromechanical systems, using differential equations, transfer functions, block diagrams, and state variables.	6 Creating
CLO2	Learn and analyze the response of systems to various different inputs.	2 Understanding 4 Analyze
CLO3	Analyze the behavior of closed loop systems using tools such as root locus, Routh Hurwitz.	4 Analyze

CLO4	Analyze the behavior of closed loop systems using tools such as Bode plots, Nyquist plots.	1 Remembering 4 Analyze
CLO5	Conduct an experiment using MATLAB/Simulink, analyze and interpret the result as they come up.	3 Applying
CLO6	Identify, formulate and solve control engineering problems.	4 Analyze 5 Evaluate

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1			L		H		M							M		L
CLO2	H				L	H		L					L		H	
CLO3				M			L				M			L		L
CLO4		L		H		M		M						M		L
CLO5					M			L				M	M			L
CLO6	H			H	L	M		M		M			L		L	L

H: High, M: Medium, L: Low