

Branch Name:	Electrical Engineering
ProgramCode:	ET213
CourseName:	Modern Control System
CourseCode:	2ET2130103T
Pre-requisiteCourse:	Fundamentals of Control System

Course Objectives:

1. To understand the background of conventional and modern control system for the real time analysis.
2. To learn the role of state space analysis, observer and controller design in the field of control system engineering.
3. To study and analyze nonlinear control systems & its stability techniques.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No	Topic	Total Hours	Weightage (%)
01	State Space Analysis of Control Systems: State Variables; State-Space Representation of Electrical, Mechanical and Electromechanical Systems; State Space Representation of nth Order Linear Differential Equation; Transformation to Phase Variable Canonical Form; Relationship Between State Equations and Transfer Functions; Characteristic Equation; Eigen Values and Eigen Vectors; Transformation to Diagonal Canonical Form; Jordan Canonical Form; Controllability Canonical Form; Observability Canonical Form; Decomposition of Transfer Function-Direct, Cascade and Parallel Decomposition; State Diagram; Solution of the Time-Invariant State Equation; State Transition Matrix and its Properties; Transfer Matrix; Transfer Matrix of Closed Loop Systems.	10	25%
02	Controllability and Observability: Concept of Controllability and Observability; Kalman's Theorems on Controllability and Observability, Gilbert's Method of Controllability and Observability; Principle of Duality; Relationship among Controllability, Observability and Transfer Function.	07	18%
03	Observer and Controller Design Design a state-feedback controller & Observer using pole placement, Steady-State Error Design via Integral Control.	05	10%

04	Non-Linear Control Systems Introduction, Common Physical Nonlinearities, The Phase Plane Method, Singular Points, Stability of Nonlinear System, Construction of Phase Trajectories, Linearization, Describing Function Method, Derivation of Describing Function, Stability Analysis by Describing Function.	08	20%
05	Liapunov Stability Analysis: Stability of Equilibrium State in the Sense of Liapunov; Graphical Representation of Stability; Asymptotic Stability and Instability; Sign-Definiteness of Scalar Function; Second Method of Liapunov; Stability Analysis of Linear Systems; Krasovski's Theorem; Liapunov Function Based on Variable Gradient Method.	08	20%
06	Implementation of digital controllers: P, PI, PID Controllers, Tunable PIDcontrollers, Methods of tuning industrial PI, PID controllers.	04	07%

Text Books:

1. Control System Engineering (Fifth Edition) by I. J. Nagrath and M. Gopal, New Age International Publishers.
2. Modern Control Engineering (Fifth Edition) by K. Ogata, EEE, PHI.

Reference Books:

1. Automatic Control Systems, High Education Press, 2003- B. C.Kuo.
2. Control System Engineering (Sixth Edition) by Norman S. Nice, John Wiley & Sons.

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the model of electrical and mechanical systems in statespace.	2 Understanding
CLO2	Design a state-feedback controller and state-feedback observer to meet transient response specifications.	6 Creating
CLO3	Understand the analysis of controllability and observability.	2 Understanding 4 Analyze
CLO4	Derive the describing function for different types of non-linearities and then do the stability analysis.	5 Evaluate 1 Remembering
CLO5	Analyze stability properties of nonlinear systems using Lyapunov stability methods	4 Analyze
CLO6	Know about use of electrical control system in general uses.	2 Understanding

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				M			L				M		M			L
CLO2			L		M			M		L		M		M	H	
CLO3		L		H		M	L		L		M	M	M			L
CLO4	L			H	L	M				L		M				L
CLO5	L				M			M		L		M		M	H	
CLO6				M			L				M		M			L

H: High, M: Medium, L: Low