

Subject Code: 1ET2130103	Subject Title: Modern Control System
Pre-requisite Subject	Fundamentals of Control System

Course Objective:

- To provide the background of conventional and modern control system for the real time analysis.
- To learn the role of state space analysis, observer and controller design in the field of control system engineering. To study and analyze non linear control systems & its stability techniques.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	-	2	4	60	40	30	20	150

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
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	30%
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.	05	20%
03	Observer and Controller Design Design a state-feedback controller & Observer using pole placement, Steady-State Error Design via Integral Control.	03	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.	05	25%
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.	05	15%

Course Outcome:

After completing this course one should be able:

1. To model electrical and mechanical systems in state space
2. To design a state-feedback controller and state-feedback observer to meet transient response specifications.
3. To derive the describing function for different types of non-linearities and then do the stability analysis.
4. To analyze stability properties of nonlinear systems using Lyapunov stability methods

List of 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, IEEE, PHI

List of 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.

List of Experiments:

1. Introduction to MATLAB for various matrix operations.
2. Simulink for various state space models
3. MATLAB program for state space representation.
4. MATLAB program for controllability and observability.
5. MATLAB program for observer design.
6. MATLAB problem for controller design.
7. MATLAB program for Lyapunov methods.
8. MATLAB program for Phase-plane trajectories.