M.TECH FIRST SEMESTER
MODERN CONTROL THEORY

17EEPC1T2 **Credits: 4**
Lecture: 4 periods/week **Internal Assessment: 40 marks**
End Semester Assessment: 60 marks

Course Objective:
The objective of this course is to explain the concepts of basic and modern control system for the real time analysis and design of control systems. This emphasizes the study and analysis concept of stability for non linear systems and to apply the comprehensive knowledge of optimal theory for Control Systems.

Course Learning Outcomes: At the end of the course the student will be able to

1. Acquire Knowledge of various terms of basic and modern control system for the real time analysis and design of control systems.
2. Perform state variables analysis for any real time system.
3. Examine any type of system for its stability, controllability and observability and implement the basic principles and techniques in designing linear control systems.
4. Formulate and solve deterministic optimal control problems in terms of performance indices.

UNIT–I: MATHEMATICAL PRELIMINARIES
Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous-time State models.

UNIT-II: STATE VARIABLE ANALYSIS
Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-time State Equations – State transition matrix and its properties. General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Canonical forms.

UNIT-III: NON LINEAR SYSTEMS
Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc– Singular Points ,Properties of Non-Linear systems – Describing function analysis of nonlinear systems. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points.

Stability Analysis: Stability in the sense of Lyapunov, Lyapunov's stability and instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method , Generation of Lyapunov functions – Variable gradient and Krasovoskii's method.

UNIT-IV: OPTIMAL CONTROL
Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of the Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.

TEXT BOOKS:

1. Modern Control System Theory by M.Gopal – New Age International -1984
2. Optimal control Theory: An Introduction by Donald E Kirk – Dovers Books on Electrical Engineering, Courier Corporation.

REFERENCE BOOKS:

1. Discrete Time Control Systems by Ogata.K – Prentice Hall – 1997
2. Digital Control Engineering M.Gopal- New Age International- 1998