IV Year B.Tech. EEE – I Semester

		L	T	P	C
23A02703a	**MODERN CONTROL THEORY (Professional Elective-V)**	**3**	**0**	**0**	**3**

Preamble:

This subject aims to study state space, design of state feedback controllers and state observers, describing function and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

Course Objectives:

CO1: To familiarize the state space representation in controllable, observable, diagonal and Jordan canonical forms. L2

CO2: Introduce the concept of controllability and observability tests through canonical forms and design of state feedback controller by pole placement technique and State Observer design. L3

CO3: Analysis of a nonlinear system using describing function approach. L4

CO4: Illustrate the Lypanov's method of stability analysis for linear and non-linear continuous time autonomous systems. L4

CO5: Formulation of Euler Laugrange equation for the optimization of typical functional and solutions. L4

Course Outcomes:

After the completion of the course the student should be able to:

CO1: Analyse different canonical forms - solution of State equation. -L4

CO2: Design of control system using the pole placement technique is given after introducing the concept of controllability and observability.-L5

CO3: Analyze nonlinear system using describing function technique and phase plane analysis. -L4

CO4: Examine the stability analysis using Lyapunov method. -L3

CO5: Illustrate the Minimization of functional using calculus of variation - state and quadratic regulator problems. -L3

UNIT I

State Space Analysis:

State Space Representation – Canonical forms – Controllable canonical form – Observable canonical form - Jordan Canonical Form - Solution of state equation – State transition matrix.

UNIT II

Controllability - Observability and Design of Pole Placement:

Tests for controllability and observability for continuous time systems – Time varying case – Minimum energy control – Time invariant case – Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement.

UNIT III

Nonlinear Systems:

Introduction to nonlinear systems - Types of nonlinearities. Introduction to phase–plane analysis - Singular points; Describing function - basic concepts - Describing functions of non- linearities.

UNIT IV

Stability Analysis By Lyapunov Method:

Stability in the sense of Lyapunov – Lyapunov's stability and Lyapunov's instability theorems – Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.

UNIT V

Calculus Of Variations:

Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints –Euler lagrangine equation.

Text Books:

1. Modern Control System Theory – by M. Gopal - New Age International Publishers - 2nd edition - 1996
2. Modern Control Engineering – by K. Ogata - Prentice Hall of India - 3rd edition - 1998.

Reference Books:

1. Automatic Control Systems by B.C. Kuo - Prentice Hall Publication.
2. Control Systems Engineering by I.J. Nagarath and M.Gopal - New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal - Tata Mc Graw–Hill Companies - 1997.
4. Systems and Control by Stainslaw H. Zak - Oxford Press - 2003.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.