I Year I Semester	L	Р	С
Code: 17PE131	4	0	3

MODERN CONTROL THEORY

(Common to PS, PSC&A, PSE, PS&C, APS, EPE, PE&ES, PE&PS, PE, P&ID, PE&ED, PE&D, PE&D, PE&S, EM&D)

(Elective-I)

Prerequisites: Control Systems, differential equations.

Course Educational Objectives:

- 1. To facilitate the evolution of state variable approach for the analysis of control systems.
- 2. To examine the importance of controllability and observability in modern control engineering.
- 3. To enable students to analyze various types of nonlinearities & construction of trajectories using describing functions and phase plane analysis.
- 4. To study the analysis of stability and instability of continuous time invariant system

UNIT –1: State Variable Analysis The concept of state – State Equations for Dynamic systems – State diagram - Linear Continuous time model for physical systems – Existence and Uniqueness of Solutions to Continuous – Time State Equations – Solutions – Linear Time Invariant Continuous – Time State Equations – State transition matrix and it's properties.

UNIT – 2: State Variable Techniques 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 Jordan Canonical form - Controllability and Observability Canonical forms of State model – State feedback controller design through pole assignment.

UNIT – 3: Non Linear Systems – I Introduction – Non Linear Systems – Types of Non – Linearities – Saturation – Dead – Zone – Backlash – Jump Phenomenon etc; - Singular Points – Introduction to Linearization of nonlinear systems, properties of Non Linear Systems – Describing function – describing function analysis of nonlinear systems- Stability analysis of Non – Linear systems through describing functions.

UNIT – 4: Non Linear Systems – II Introduction to phase – plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase – plane analysis of nonlinear control systems.

UNIT – **5**: Stability Analysis Stability in the sense of Lyapunov, Lyapunov's stability and Lyapunov's instability theorems – Stability Analysis of the Linear Continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

Course Outcomes:

After completion of this course the students will be able to:

- Understanding the state variable approach is suitable for higher order.
- To analyze the concepts of controllability and observability.
- To analyze the various non-linearities through describing functions and phase plane analysis.
- Typical issues of stability and instability of continuous time invariant systems.

Reference Books:

- 1. Modern Control System Theory by M. Gopal New Age International 1984
- 2. Modern Control Engineering by Ogata. K Prentice Hall 1997
- 3. Nonlinear systems, Hassan K. Klalil, Prentice Hall, 1996

4. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India, 2009.