

# 20PE010 - MODERN CONTROL THEORY

## UNIT – I

L- 10

**Math Modeling of Dynamical Systems:** Newtonian and Lagrangian approaches, concept of dynamical state of a system, concept of equilibrium point, linearisation of non-linear model.

## UNIT – II

L- 10

**Review of Linear Algebra concepts:** Field, Vector space, linear combination, linear independence, bases of a vector space, representation of any vector on different basis, matrix representation of a linear operator, change of basis, rank, nullity, range space and null space of a matrix, Eigen value and Eigen vector of a matrix, similarity transform, diagonalisation.

## UNIT – III

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Modern Control Analysis and stability analysis: Concept and computation of systems modes, controllability theorem and its proof, observability theorem and its proof, controllable and observable subspaces. Stability of linear systems, stability types and their definitions for any general system, stability of an equilibrium point, Lyapunov stability theory for LTI systems, quadratic forms and Lyapunov functions.

## UNIT – IV

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Modern Control Design: Converting the math model to controllable canonical form and its use for pole placement, concept of linear observer and its design, design of reduced order observer, compensator design using separation principle, poles of compensator, open-loop and close-loop systems.

## UNIT – V

L- 10

Optimal Control Theory: Introduction to the philosophy of optimal control, formulation of optimal control problem, different performance criterion, linear quadratic regulator (LQR) and optimum gain matrix, Riccati equations, conceptual models and statistical models for random processes, Kalman filter.

## TEXT BOOKS:

1. Control System Design: An Introduction to State-Space Methods, Bernard Friedland, Dover Publications, Inc. Mineola, New York.
2. Linear Systems, Thomas Kailath, Prentice-Hall Inc., New Jersey.

## REFERENCES:

1. Modern Control System Theory, M. Gopal, New Age International (P) Limited, New Delhi.
2. Linear System Theory and Design, Chi-Tsong Chen, Oxford University Press Inc., New York.