LINEAR SYSTEMS THEORY

PROF. RAMKRISHNA PASUMARTHY
Department of Electrical Engineering
IIT Madras

PRE-REQUISITES : Linear Algebra, Differential Equations, Control Systems Engineering

INTENDED AUDIENCE : Graduate Students from Electrical / Mechanical/ Aerospace/ Chemical Engineering

COURSE OUTLINE :

This course will provide a thorough introduction to the theory of Linear Systems with emphasis on Control related concepts. First, mathematical models describing the fundamental properties that govern the behavior of systems will be developed. We will cover time invariant, time varying, continuous and discrete time systems. This course will cover concepts of stability, controllability, observability, and design and serve as necessary foundation for further study in the area of systems and control.

ABOUT INSTRUCTOR :

Prof. Ramkrishna Pasumarthy is currently an Assistant Professor at Department of Electrical Engineering, IIT Madras. He obtained his PhD in systems and control from University of Twente, The Netherlands and held post doc positions at University of Melbourne and UCLA. His research interests are in the areas of network science with applications to power, traffic cloud and brain networks. also associated with the Robert Bosch Center for Data Sciences and Artificial Intelligence at IIT Madras. He also has interests in medical wearable devices and is a co funder of a start up iMov Motion Tech pvt. ltd. incubated at IITM Research Park

COURSE PLAN :

Week 1: Introduction to Linear systems with Examples

Week 2: Math Preliminaries I - Vector Spaces, Bases, Coordinate Transformation, Invariant Subspaces, Inner product, Norms

Week 3: Math Preliminaries II - Rank, Types of Matrices, Eigen values, Eigen vectors, Diagonalization, Matrix Factorization

Week 4: State Transition Matrix, Solutions to LTI Systems, Solutions to LTV Systems

Week 5: Equilibrium points, Linearization, Types of Linearization with Examples

Week 6: Stability, Types of Stability, Lyapunov Equation

Week 7: Controllability, Reachability, Stabilizability, Tests, Controllable and Reachable Subspaces, Grammians, Controllable Decomposition

Week 8: Observability, Constructibility, Detectability, Tests, Subspaces, Grammians, State Estimation, Observable Decomposition

Week 9: Kalman Decomposition, Pole Placement, Controller Design

Week 10: Observer Design, Duality, Minimal Realization

Week 11: Basics of Optimal Control, LQR, Ricatti Equation

Week 12: LMIs in Control