

# **ECE 5413**

## **Control Theory Spring 2003**

**Instructor: Sesh Commuri**

### **Prerequisites**

ECE4413

**What you need to know** Matrix Theory, Concept of Eigen Values, Eigen Vectors and Similarity Transforms, Basic understanding of Linear Algebra, Solutions of Ordinary Differential Equations, State Variable Representation of Systems, and Use of Matlab.

**What you will learn** Mathematical Analysis of Linear and Nonlinear Systems and the concepts of Stability, Controllability, and Observability. We will also cover the fundamentals of System Identification.

### **Syllabus**

1. Review of Mathematical Principles.
2. State Space Descriptions – Some Basic Concepts.
  - Canonical Realizations
  - Discrete-Time representations of Linear systems
  - Observability and Controllability for Continuous and Discrete-Time realizations
  - Stability Theory for Linear Systems
3. State Variable Feedback
  - Stabilization by Output Feedback
  - State Variable Feedback and Controllability
  - Quadratic Regulator Theory
4. Nonlinear Systems Analysis
  - Fundamentals of Lyapunov Theory
  - Control Design Based on Lyapunov's Direct Method
5. Advanced Stability Analysis for Nonlinear Systems
  - Stability for Non-Autonomous Systems
  - Lyapunov Analysis of Non-Autonomous Systems
  - Positive Linear Systems and Passivity

6. Feedback Stabilization
  - Input-Output Linearization
  - Input-State Linearization
7. Sliding Mode Control
8. System Identification
  - Classical Estimation Theory
  - Continuous-Time Kalman Filter
  - Discrete-Time Kalman Filter

## **Recommended Texts**

1. Linear Systems, Thomas Kailath, Prentice Hall, Inc., NJ, 1980.
2. Applied Nonlinear Control, Jean-Jacques E. Slotine, Weiping Li, Prentice Hall, Inc., NJ 1991.

## **Schedule**

3 Lectures per week; 50 minutes per Lecture.

## **Assessment Methods Used**

1 Mid-Term Exam contributing  $33\frac{1}{3}\%$  of the final grade.

1 Term Project contributing  $33\frac{1}{3}\%$  of the final grade.

15 Assignments contributing  $33\frac{1}{3}\%$  of the final grade.