

E209A Analysis and Control of Nonlinear Systems
<http://www.stanford.edu/class/engr209a/>
Course Outline

Professor C. Tomlin
Department of Aeronautics and Astronautics
Stanford University
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Lecture Information

Lectures: TTh 11-12.30, GESB 131.
Section: TBD

Contacts

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Course Description

First graduate level course in nonlinear systems. Introduction to nonlinear phenomena: multiple equilibria, limit cycles, bifurcations, complex dynamical behavior. Planar dynamical systems, analysis using phase plane techniques. Describing functions. Input-output analysis and stability. Lyapunov stability theory. Feedback linearization, sliding mode control.

The course will be punctuated by a rich set of examples, ranging from violin strings to jet engines, from heart beats to artificial neurons, and from population growth to nonlinear flight control.

- Introduction to Nonlinear Phenomena: Multiple Equilibria, Limit Cycles, Complex Dynamics, Bifurcations
- Second Order Nonlinear Systems: Phase Plane Techniques, Limit Cycles - Poincare-Bendixson Theory, Index Theory
- Input-output analysis and stability: Small Gain Theorem, Passivity, Describing Functions
- Lyapunov Stability Theory: Basic stability and instability theorems, LaSalle's theorem, Indirect method of Lyapunov
- Linearization by State Feedback: Input-Output and Full State Linearization, Zero Dynamics, Inversion, Tracking, Stabilization

Prerequisites

Feedback Control (E205) or Linear Systems (EE263). Linear Algebra (Math. 103, 113). Exposure to differential equations. Exposure to MATLAB strongly recommended.

Evaluation

Problem sets will be put on the web Thursdays (due the following Thursdays).

Course Grades: HW (30%); Midterm (30%); Final (40%)

Policies

It is encouraged that you work in groups, however each person must hand in his/her own HW.

HW is due by 5pm in the filing cabinet drawer (marked E209A) outside Durand 023. If homework is late, your graded score on that homework will be multiplied by $(0.75)^d$ where d is actual days late. Solution sets will be made available one week after HW is due, and HW will not be accepted after this.

Course References:

The course is based on a set of lecture notes which will be made available throughout the term.

The following are reference texts which are available in the bookstore.

S. S. Sastry. Nonlinear Systems: Analysis, Stability, and Control. Springer-Verlag, 1999.

H. K. Khalil. Nonlinear Systems, 3rd Edition. Prentice-Hall, 2002.