# ECE 236 / ME 236: Nonlinear Control Systems

Winter 2004, 4 credits

**Instructor:** Prof. Andy Teel  
5121 Eng. I  
893-3616  
teel@ece.ucsb.edu

**Lectures:** TTh: 2 – 3:50 pm  
1431 Phelps Hall

**Office Hours:** TTh: 4 – 5pm (or stop by...)

text:  
H.K. Khalil  
*Nonlinear Systems (3rd Ed.)*  
Prentice-Hall, 2002

**Grading:** Final Exam 60%  
Midterm Exam 40%

## COURSE TOPIC

Nonlinear stability theory (very little control; see ECE 237), with more emphasis on discrete-time systems (see supplemental notes) than in past years.

## COURSE OUTLINE

1. **Review of linear systems stability theory**  
   Exponential stability, stability, detectability, dissipativity, interconnections, Lyapunov functions, converse Lyapunov theorems. *Supplemental notes & various locations in Khalil.*

2. **Characteristics of nonlinear dynamics compared to linear dynamics**  
   Multiple isolated equilibria, limit cycles, finite escape time, existence / uniqueness / continuous dependence of solutions, stability boundaries. *Khalil ch. 1-3 & Supplemental notes.*

3. **Qualitative analysis in the neighborhood of equilibria**  
   Stability definitions, Lyapunov theory, center manifold theory, invariance theorems. *Khalil chapters 4 & 8.*

4. **Stability under perturbations**  
   Input to state / output stability properties, absolute stability, interconnected systems, nonlinear small gain theorem, passivity, averaging, singular perturbations. *Khalil ch. 5-7,9-11.*

## PREREQUISITES

Some knowledge of Linear Systems (ECE 230A /ME 243A) assumed.

## SUPPLEMENTAL NOTES

Available at http://www-ccec.ece.ucsb.edu/people/teel/236/