

# COURSE SYLLABUS SPRING 2007

## GE 422/ECE 489/ME 446 Robot Dynamics and Control

**Meeting Schedule:** T,TH 11:30-12:50 in 252 MEB

**Instructor:** Professor Mark W. Spong, Office: 149 CSL, Email: [mspong@uiuc.edu](mailto:mspong@uiuc.edu)

**Instructor Office Hours:** W 1:30-2:30 in 149 CSL

**Teaching Assistant:** Silvia Mastellone, Email: [smastel2@uiuc.edu](mailto:smastel2@uiuc.edu)

**TA Office Hours:** T, Th 2:00-3:00 in 154 CSL

**Class Homepage:** <http://courses.ece.uiuc.edu/ece489>

**Text:** M.W. Spong, S. Hutchinson, M. Vidyasagar, *Robot Modeling and Control*, John Wiley & Sons, Inc. 2006

### Course Outline:

1. Rapid Review of Kinematics
  - Homogeneous Transformations
  - Forward and Inverse Kinematics
  - Jacobians
2. Dynamics
  - Euler-Lagrange Equations of Motion
  - Properties of Robot Dynamics
  - Examples
3. Independent Joint Control
  - Actuator Dynamics
  - PI/PID Control
  - Drive-Train Dynamics
  - Feedforward Control
4. Introduction to Nonlinear Systems
  - Equilibria
  - Lyapunov Functions and Stability
  - LaSalle's Invariance Principle
5. Multivariable Control
  - Inverse Dynamics
  - Passivity-Based Robust and Adaptive Control
6. Force Control
  - Natural and Artificial Constraints
  - Impedance Control
  - Hybrid Control
7. Geometric Methods
  - Manifolds and Tangent Spaces
  - Frobenius Theorem
  - Feedback Linearization
  - Nonholonomic Systems
  - Chow's Theorem
  - Examples
8. Visual Servo Control
  - Basic Concepts in Computer Vision
  - Image-Based vs. Position-Based Control
  - Partitioned Approaches to Control
  - Motion Perceptibility

**Labs:**

There are no formal lab meetings. Lab assignments will be based on Matlab simulations.

**Grading:**

Grades will be determined based on homeworks, lab reports, and a final project according to the following percentage. There will be no exams.

Labs	20 %
Homeworks	50 %
Final Project	30 %

Instructor Discretion (attendance, participation, etc.) will be used for plus/minus grades  
*Homework is due at the beginning of class. No credit will be given for late homework.*

**Homework Assignments:**

**Homework 1: January 30**

**Homework 2: February 13**

**Homework 3: February 27**

**Homework 4: March 13**

**Homework 5: April 3**

**Homework 6: April 17**

**Laboratory Assignments and Final Project:**

**Lab 1: February 8**

**Lab 2: March 8**

**Lab 3: April 5**

**Final Project: May 12**