ECE 555 **_Control of Stochastic Systems_** Spring 2011

Prof. Sean Meyn, meyn@illinois.edu Tuesday & Thursday 241 EL, 3:30–4:50 pm

This course introduces both the analytical and computational aspects of stochastic control and performance evaluation, with applications to engineering, computer science, economics, and management science. Topics include Markov models and stochastic stability, development of control laws by dynamic programming, complete and partial information, Kalman filtering, and an introduction to machine learning.

It is intended for graduate students who have some background in control and stochastic processes. Experience with *Matlab* is also desirable.

References: The following textbooks are on reserve in the Engineering Library.

P. R Kumar, *Stochastic systems: Estimation, identification, and adaptive control.*

Torsten Soderstrom, *Discrete-time stochastic systems: estimation and control.*

The following are available free on-line (send your thanks to Cambridge University Press):

S. P. Meyn and R. L. Tweedie, *Markov Chains and Stochastic Stability.*
https://netfiles.uiuc.edu/meyn/www/spm_files/book.html

S. P. Meyn, *Control Techniques for Complex networks.*
https://netfiles.uiuc.edu/meyn/www/spm_files/CTCN/CTCN.html

Office hours Wednesdays from 4:00-5:00p.m. (sometimes extended to 5:30) — CSL 154. I can be reached for questions by electronic mail at meyn@illinois.edu.

Exams, homework, and grading Homework problems will be assigned on a bi-weekly basis, to be handed in at the beginning of class on the date due. They will be graded and returned the following week. *Late homework cannot be accepted.*

There will be two evening midterm exams, March 16 and April 20, from 7:00 - 8:30 p.m. in our classroom, 241 EL. You will be allowed *one* sheet of notes ($8\frac{1}{2} \times 11$; both sides) in the first exam, and *two* in the second. Otherwise, the exams are closed-book and closed-notes.

Tentative grading scheme: Homework problems will count 20%, the midterm exam 25%, and the final will count 30% towards the final grade in the course.

Course Outline

I. Markov Models

1) Overview and examples.
2) Linear and non-linear models.
3) Representations of π and value functions.
4) Lyapunov theory.

II. Optimal Control

1) Controlled Markov chain models.
2) Markov and stationary policies.
3) Numerical techniques: Policy and value iteration, LP methods.
4) Partial information

First Midterm Exam, *(7:00-8:30 p.m., Wednesday, March 16)*

Spring Break: March 21–25.

III. *Linear Theory*

1) Linear Gaussian systems.
2) Optimal linear-quadradic and minimum-variance control.
3) Partial information and the Kalman filter.

Second Midterm Exam, *(7:00-8:30 p.m., Wednesday, April 20)*

IV. *Adaptation and Learning.*

1) Stochastic approximation.
2) Approximate dynamic programming.
3) Introduction to adaptation and machine learning.

Final Exam *(1:30-4:30 p.m., Friday, May 13)*