SYST 201: Discrete Dynamic Systems Modeling

Fall 2004

Course Overview

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An important problem in engineering is to predict the behavior of systems that change in time. Such systems are called *dynamical systems*. This course introduces students to a set of mathematical methods used to model dynamical systems. In particular, students will learn to:

Identify real world problems that can be modeled as dynamical systems.
Take such systems and translate them into mathematical models.
Predict the bahavior of such systems using mathematical analysis and computation.

Students will use engineering mathematics as well as computers to simulate the behavior of dynamical systems and make predictions about the systems. This course focuses on *discrete* dynamical models in which time is viewed as a sequence of steps.

Class Hours: Tue / Thu, 10:30 am - 11:45 am, Sci & Tech II, rm 15

Prerequisite: MATH 114

Instructor: John Shortle
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703-993-3571
Science & Tech II, room 313
Office hours: Tue 9:15 – 10:15 am, 3:30 – 4:30 pm

Textbook: J. Sandefur, *Discrete dynamical modeling*, Oxford University Press, 1993.

Course Syllabus

1. *Introduction*. Systems engineering. The use of models in Systems Engineering. Introduction to dynamic modeling.
2. *Introduction to modeling*. Converting real world problems into mathematical models. Solutions and analysis using spreadsheets. Various applications. The cobweb model and stability.
3. *First order dynamic systems*. Linear and nonlinear models. Solutions and properties. Applications from linguistics, genetics, finance, and international competition.
4. *Probability and dynamical systems*. Elements of probability. Simple Markov chains
5. *Dynamic systems with inputs*. Exponential terms. Polynomial terms. Fractal geometry. Economic systems.
6. *Higher order linear systems*. National economic models. Oscillations and the vibrating string.
7. *Nonlinear dynamic systems*. Linearization; computational models. Simulation. Population models; logistics models; predator-prey models.
8. *Markov chains*. Regular Markov chains. Absorbing Markov chains. Applications. Simulation.

Student Evaluation Criteria

Homework assignments	15%
Class participation	5%
Group project	10%
Midterm 1	20%
Midterm 2	20%
Final exam	30%

Schedule for Fall 2004

Tue. Aug. 31	Lec. 1, Introduction	
Thu. Sep. 2	Lec. 2, Modeling	
Tue. Sep. 7	Lec. 3, Modeling	Hmwk #1 due
Thu. Sep. 9	Lec. 4, Chapter 1	
Tue. Sep. 14	Lec. 5, Chapter 1	Hmwk #2 due
Thu. Sep. 16	Lec. 6, Chapter 2	
Tue. Sep. 21	Lec. 7, Chapter 2	Hmwk #3 due
Thu. Sep. 23	Lec. 8, Chapter 3	
Tue. Sep. 28	Lec. 9, Chapter 3	Hmwk #4 due
Thu. Sep. 30	Lec. 10, Chapter 3	
Tue. Oct. 5	Review	Hmwk #5 due
Thu. Oct. 7	Exam 1 (Ch. 1,2,3)	
Tue. Oct. 12	Columbus Day	
Thu. Oct. 14	Lec. 11, Chapter 4	Group project mid-reports due
Tue. Oct. 19	Lec. 12, Chapter 4	Hmwk #6 due
Thu. Oct. 21	Lec. 13, Chapter 4	
Tue. Oct. 26	Guest Lecture	Hmwk #7 due
Thu. Oct. 28	Lec. 14, Chapter 5	
Tue. Nov. 2	Lec. 15, Chapter 5	Hmwk #8 due
Thu. Nov. 4	Lec. 16, Chapter 5	
Tue. Nov. 9	Lec. 17, Chapter 6	Hmwk #9 due
Thu. Nov. 11	Lec. 18, Chapter 6	
Tue. Nov. 16	Lec. 19, Chapter 6	Hmwk #10 due
Thu. Nov. 18	Review	
Tue. Nov. 23	Exam 2 (Ch. 4, 5, 6)	Hmwk #11 due
Thu. Nov. 25	Thanksgiving	
Tue. Nov. 30	Lec. 20, Chapter 8	
Thu. Dec. 2	Lec. 21, Chapter 8	Group projects due
Tue. Dec. 7	Lec. 22, Chapter 8	
Thu. Dec. 9	Review	Hmwk #12 due
Thu. Dec. 16	Final Exam, 10:30am – 1:15pm	