SYST 611
Spring 2012

Instructor: Dr. Frederick Wieland
Innovation Hall 131
7:20—10 PM Tuesdays

Overview

This course is a course in the mathematics of dynamic systems. A "dynamic system" is a system that evolves in time—one or more of the state variables of the system changes as a function of time. We will study both discrete and continuous dynamic systems, with an emphasis on how to set up those systems given common situations (modeling), solve the resulting differential equations (mathematics), and control the resulting system where possible (control theory). Examples from economics, finance, mathematics, physics, electrical engineering, social science, and military dynamics will all be presented and studied. The properties of such dynamic systems will be analyzed, and by the course end you will have a greater insight into the nature of dynamic systems, how to model them, and how to control them.

Textbooks

Required text:

> David G. Luenberger, "Introduction to Dynamic Systems: Theory, Models, and Applications"

Optional text:

> Joseph J. DiStefano III, Allen R. Stubberud, and Ivan J. Williams, "Feedback and Control Systems," Schaum's Outline Series.

Prerequisite Knowledge
Course SYST 500. You should have a thorough foundation in algebra, as well as knowledge of linear algebra (see Luenberger chapter 3), and some understanding of differential equations (although we will thoroughly study both them and difference equations during this class).

Course Outline

Date	**Topic**	**Readings (**L=Luenberger)
1/24	Partial Fraction Expansion	L 263-266
1/31	Difference equations and the Z-transform	L section 2.1-2.7, L pages 138-139, and sections 8.2-8.3. and L chapter 3.
2/7	State variable representation for difference equations. Differential equations and the LaPlace Transform	L sections 4.1-4.5, plus some miscellaneous topics from the previous reading
2/14	State variable representation for differential equations. Example applications for differential equations.	L 2.8-2.10 and L 4.6-4.7, and L pages 139-141, and L section 8.5.
2/21	Equilibrium and stability of solutions; oscillating	Miscellaneous topics from

	solutions.	previous readings
2/28	Examples of differential and difference equation applications	L 5.9-5.12
3/6	Diagrammatic representation of systems; controllability of systems; observability. Midterm review.	
3/13	**Spring Break**	
3/20	Midterm Exam, normal class time (7:20-10 PM)	
3/27	Feedback control and the PID controller	L 8.6-8.10
4/3	Discrete probability models (Markov chains)	L Chapter 7 (entire)
4/10	Continuous time probability models (Markov processes) and queueing theory	L Chapter 9 (entire, over two weeks)
4/17	Nonlinear systems	L Chapter 9
4/24	Models of linear and nonlinear systems	L Chapter 10
5/1	Final exam review	
5/8	**Reading Week**	
5/15	**Final Exam, 7:30—10:15 PM (note times!)**	

Course Policies

- Homework will be issued weekly, and should be submitted on-line through the "Blackboard" system. If you are having trouble accessing the Blackboard system, then please contact the GMU Blackboard help desk.
- If you write your homework by hand, please use a dark pen or pencil on a blank white sheet of paper. It shows up best in the scan.
- Collaboration is allowed (and even encouraged) on the homeworks, but keep in mind that the midterm and final will be your own solitary work.-
- Homework is due at the beginning of the next class after it has been assigned. Late homeworks are not accepted. Even if you are traveling, you should be able to access the internet and upload your homework.
- Midterm and Final Exams will be in-class.
- If GMU is closed, for example because of inclement weather, then homework due that day is automatically due the next time class meets.
- Class attendance is optional, although most students find it helpful to attend the live lecture.
- Grading policy is as follows:
    - Homework: 30% of the grade. Your lowest homework score is dropped before the homework grade is averaged.
    - Midterm: 30% of your grade.
    - Final exam: 40% of your grade.
- Contacting instructor and office hours. Extra help can be arranged at your convenience by emailing the instructor.
- **Emailing instructor**. The instructor's email address is fredwieland@hotmail.com. *Please put the words "SYST 611" as the first words in the subject line of the email so that the instructor will read the message.*