Montana State University
Department of Electrical and Computer Engineering

EE321 – Control Systems I

Course Information
Last revised: January 19, 2007

Spring 2007

Lecture	Monday, Wednesday and Friday 12:00-12:50 in Roberts 113
Lecturer	Steven R. Shaw, Cobleigh 532, `sshaw@matrix.coe.montana.edu`
Office hours	TBA
Prerequisites	EE207, EE308
Text	*Feedback Control Systems*, Third Edition, John Van de Vegte Prentice Hall, 1994.

1 Description

EE321 is the first in a two course series in control systems. EE321 begins with synthesis and analysis of continuous time, single variable, feedback control systems using a transfer function approach. The second course, EE422, emphasizes a discrete time, state-space approach to analysis and synthesis of control systems.

In EE321, you will become experts with some skills that should already be familiar, including:

- System properties (linearity, time invariance, causality)
- Time and frequency domain representations of signals and systems
- Complex numbers, poles and zeros
- Laplace transform
- Bode plots
- Stability concepts

EE321 will include the following topics:

- modeling of electrical and mechanical systems
- use of signal-flow and block diagrams
- use of Matlab to simulate and design control systems
- design and analysis of various control strategies
- Root-locus, Nyquist and pole placement techniques
- introduction to describing functions

The problem sets will be very challenging. You should look over each problem set as it becomes available and start immediately. You will be able to get your questions answered in class and office hours if you start early and identify challenging areas before the problem set is due.

2 Policies

2.1 Office hours

Office hours were very important before professors had phones, answering machines, or email. In those days, office hours gave students a predictable window of opportunity to communicate with their instructors. Some argue that office hours are irrelevant given modern communications. I don't believe this is true. However, I have made some frustrating observations about office hours.

1. As a first approximation, students do not come to my office hours, even though few have conflicts.
2. Students complain that I don't have enough office hours.

These apparently contradictory observations suggest that office hours are misunderstood. Office hours are a window of time that I reserve to be maximally available to students. During this time I typically interact with students for advising, class help, or even casual conversation. The existence of office hours does not imply that students are not welcome at other times. However, if you stop by outside of office hours, I may ask you to come back another time. This isn't personal, I just need to do something else. If my door is shut you should come back another time. If my door is shut during office hours, please knock. Email is great too.

Please come to office hours. Think of office hours as part of the class that you are in charge of. I don't lecture in office hours, nor do I work homework problems. However, I will help you get "unstuck" on homework, or clear up confusing points. I often have refreshments available.

2.2 Collaboration and Intellectual Honesty

Groups of people with different bits of knowledge can learn very effectively together. Much engineering is done collaboratively because groups sometimes work and innovate very quickly. However, the educational advantages of group work disappear if you simply write down the answers while someone else does the problem.

In this class all problem set solutions must be written up independently. You are more than welcome to discuss how to do the problems with your classmates. Any problem set or fraction of a problem set that shows evidence of being copied will cause all parties to be referred to dean's office. Scores for copied work will be assigned at my discretion.

2.3 Exams and Quizzes

Exams are closed book. There will be two mid-term exams and one final exam. The exams will attempt to measure your ability to use and extend ideas rather than your ability to memorize. In the interest of fairness, examinations other than at the scheduled times will be considered only in extenuating circumstances.

The exam schedule for EE321 is as follows.

Exam 1	Wednesday February 28, in-class
Exam 2	Wednesday March 28, in-class
Final Exam	see official exam schedule

Quizzes are open book and unannounced. Typically, 5 to 10 minutes of class time will be allowed for the quiz.

2.4 Problem Sets

Problem sets are due *in class on the day specified on the problem set.* Late problem sets will be discarded, unless arrangements have been made for extenuating circumstances at least one day prior to the due date. Please refer to the policy on "Collaboration and Intellectual Honesty."

2.5 Grading

The numerical final grade will be weighted sum of two midterm exams (M_1 and M_2), a problem set grade P, a quiz grade Q, and the final exam F. If all of these grades are expressed as percentages, the numerical final grade will be

$$.3P + .15M_1 + .15M_2 + .3F + .1Q.$$

Letter grades will be assigned by partitioning the distribution of numerical grades. As a bare minimum, any numerical final grade exceeding 90% will correspond to an A, 80% for a B, etc. Generally, the partitioning method results in thresholds that are much more generous.

I will make mistakes as I grade the problem sets. These mistakes are just as likely to occur in your favor as not. Each homework problem is worth roughly 0.3% of your final grade. Therefore, no changes to problem set grades will be considered. No credit will be given for late problem sets.

2.6 Letters of Achievement and Recommendation

Occasionally, a student will achieve a level of performance that is truly exceptional. Such performance exceeds reasonable standards for the course and therefore cannot be rewarded sufficiently with a grade. In these cases, the student, dean, and department head will receive a formal letter of commendation documenting the student's achievements.

I am always willing to testify to your accomplishments in EE321 should you need a letter of recommendation for any purpose.

2.7 Cancellations and Holidays

There will be no class and no office hours on university holidays. In 2007 these include February 1, the week of March 12, and April 6. The last day of classes is May 4.

3 Syllabus

Week	Topics
1	Introduction to feedback control. Examples. Linearization, control system properties, algebra.
2	Modeling, examples, transformations, block diagrams.
3	Stability, qualitative performance, approximations.
4	Transient response. Performance measures.
5	Simple compensators. Introduction to root locus.
6	Exam 1. Root locus analysis.
7	Root locus design.
8	Nyquist plots. Principle of the argument.
9	Relative stability. Bode plots.
10	Frequency response analysis.
11	Exam 2. Frequency response series compensator design. proportional, dominant pole
12	Frequency response series compensator design. PI, PD, PID, lag and lead
13	Minor loop compensation. Design for nonminimum phase, unstable, and pure delay plants.
14	Describing function analysis.
15	Overview of modern and digital control. Eigenvalues. Full-state feedback.

Hint: Read the chapters *before* the start of the week.

Office Hours Response Form

Please cross out the times on the following schedule that are NOT available for office hours.

Monday	Tuesday	Wednesday	Thursday	Friday
9	9	9	9	9
10	10	10	10	10
11	11	11	11	11
	12		12	
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4

Please return to instructor at the end of class.