

University of Utah

ME EN 5210/6210 & CH EN 5203/6203

State-Space Control Systems

Spring 2013

Meeting time: Tuesday & Thursday 9:10-10:30, WEB 2230; Office Hours: TBD

Instructor:

Dr. Jake Abbott, Kennecott 130, e-mail: jake.abbott@utah.edu, Ph: (801) 585-6672

Course Objectives:

In State-Space Control Systems, we will learn how to analyze and design systems expressed as coupled linear first-order differential equations. As an alternative to Classical Control Systems (ME EN 5200/6200), which makes use of the Laplace transform to analyze and design single-input/single-output (SISO) systems, state-space methods allow us to analyze and design multi-input/multi-output (MIMO) systems in time domain. We will consider both continuous-time and discrete-time equations. Control systems are used to regulate the temperature in a room, to command a robot arm along a desired trajectory, to autopilot an airplane, and to ensure that manufacturing processes stay within specifications. A course in control systems provides a student with a common language with which to qualitatively and quantitatively discuss system performance and specifications. In addition, state-space methods are used to analyze a variety of systems that, at first, seem quite distinct from engineering systems, including economic and social models.

Prerequisites:

Students should have been exposed to linear algebra and differential equations. Students should have also been exposed to modeling of dynamic systems (mechanical, electrical, etc.). If any of these prerequisites is not met, the student should speak to the instructor about it, and should consider taking such a course.

Text (required):

Linear System Theory and Design, Third Edition, Chi-Tsong Chen, ISBN 0-19-511777-8

Course Web Page:

<http://www.telerobotics.utah.edu/index.php/StateSpaceControl>

The course web page contains the syllabus, which will be updated dynamically with readings, assignments, etc. Students are expected to do the reading for a given day before coming to class. Each of the lecture topics has associated tutorial videos. These videos are not required viewing, but are intended to supplement information when needed. Students might consider watching the videos before or after lectures to determine what is most effective for their learning.

Homework:

There will be a homework assignment most weeks, assigned on Friday (approximately) and due the following Friday at 5:00 pm in the marked box in front of the Mechanical Engineering front office in MEB. Homework will be returned in another marked box in the same location. Homework will be graded on a four-point scale as follows. Only one problem will be selected for thorough grading: that problem will receive a 3 for being perfect or close to perfect, a 2 for a good effort but with some major error, a 1 for a poor effort, and a 0 if it was not attempted. Additionally, the fourth point will be given if a good effort was made on the entire assignment (i.e., all problems were attempted with a good effort). No late homework will be accepted under any circumstances, but the lowest two homework scores will be dropped automatically.

Discussion of homework and teamwork are encouraged, but each student must complete each assignment individually. MATLAB will be required for many of the assignments. Figures and computer programs cannot be shared. Copying homework is unacceptable and will result in a zero homework grade for everyone involved. Groups of students who work together have the right to ask a fellow student to leave their study groups if that student does not contribute to their group.

Quizzes:

Pop quizzes will be relatively simple questions that test basic comprehension. There will be no make-up quizzes, but the lowest two quizzes will be dropped automatically. Quizzes are graded on a two-point scale as follows: one point is for attendance, and one point is for a correct answer.

Labs:

There will be a few hands-on labs to demonstrate the methods we learn on a real system. These labs will be discussed in more detail throughout the semester. Labs can be done on the students' time.

Examinations:

There will be one midterm exam during the semester and one comprehensive final exam. All examinations must be taken at the scheduled time unless prior arrangements are made at least two weeks before the exam. The student is allowed to bring a calculator to the exam; no other books or notes are allowed.

Accommodations will be arranged if a student has a special requirement due to a disability. It is the responsibility of the student to request these accommodations and provide documentation specifying the arrangements from the University of Utah Center for Disability Services (see below).

Grading:

Homework:	20%
Lab:	10%
Quizzes:	10%
Midterm Exam:	25%
Final Exam:	35%

The instructor reserves the right to make changes to any course policies.

Cheating and Plagiarism:

Anyone found to be cheating on an exam or quiz, copying homework from solutions manuals, plagiarizing reports or papers of any kind will receive an E for the class. Keep your eyes on your own work during exams and quizzes to avoid the appearance of cheating.

A Culture of Respect:

State-Space Control Systems is a challenging class, and it will take a lot of your time and hard work. However, you learn a lot of valuable skills that are useful in many aspects of engineering. It is your responsibility to stay engaged and caught up. No laptops or other distracting electronic devices will be permitted in class.

COLLEGE OF ENGINEERING GUIDELINES

<http://www.coe.utah.edu>

Spring Semester 2013

Appeals Procedures

See the Code of Student Rights and Responsibilities, located in the Class Schedule or on the UofU Web site for more details

Appeals of Grades and other Academic Actions

If a student believes that an academic action is arbitrary or capricious he/she should discuss the action with the involved faculty member and attempt to resolve. If unable to resolve, the student may appeal the action in accordance with the following procedure:

1. Appeal to Department Chair (in writing) within 40 business days; chair must notify student of a decision within 15 days. If faculty member or student disagrees with decision, then,
2. Appeal to Academic Appeals Committee: see <http://www.coe.utah.edu/appeals> for members of committee and procedures. See II Section D, Code of Student Rights and Responsibilities for details on Academic Appeals Committee hearings.

Americans with Disabilities Act (ADA)

The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you need accommodations in a class, reasonable prior notice needs to be given to the instructor and to the Center for Disability Services, 162 Olpin Union, 581-5020 (V/TDD) to make arrangements for accommodations. All written information in a course can be made available in alternative format with prior notification to the Center for Disability Services.

Repeating Courses

When a College of Engineering class is taken more than once, only the grade for the second attempt is counted. Grades of **W**, **I**, or **V** on the student's record count as having taken the class. Some departments enforce these guidelines for other courses as well (e.g., calculus, physics). See an advisor or departmental handbook. Students should note that anyone who takes a required class twice and does not have a satisfactory grade the second time may not be able to graduate.

Withdrawal Procedures

See the Class Schedule or web for more details ** Please note the difference between the terms “drop” and “withdraw”. Drop implies that the student will not be held financially responsible and a “W” will not be listed on the transcript. Withdraw means that a “W” will appear on the student's transcript and tuition will be charged. **

Drop Period – No Penalty

Students may DROP any class without penalty or permission during the FIRST TEN calendar days of the term (Wednesday, January 16, 2013).

Withdrawal from Full Term Length Classes

Students may WITHDRAW from classes without professor's permission until **Friday, March 1, 2013**. Please note that a “W” will appear on the transcript and tuition will be charged. Refer to Class Schedule, Tuition and Fees for tuition information.

Withdrawal from Session I and Session II

See the web page, for details:

<http://registrar.utah.edu/academic-calendars/spring2013.php>

Withdrawals **after March 1** will only be granted due to **compelling, nonacademic emergencies**. A petition and supporting documentation must be submitted to the Dean's Office, 1610 Warnock Engineering Building or University College (450 SSB) if you are a pre-major. Petitions must be received before the last day of classes (before finals week).

Adding Classes

Please read carefully: All classes must be added within two weeks of the beginning of the semester (deadline: September 7th). Late adds will be allowed January 22 through January 28, 2013, requiring only the instructor's signature. Any request to add a class after January 28 will require signatures from the instructor, department, and dean, and need to be accompanied by a petition letter to the Dean's office.

A \$50 Per Class FEE WILL BE ASSESSED BY THE REGISTRAR'S OFFICE FOR ADDING CLASSES AFTER January 28. ***