The University of New Mexico

Electrical and Computer Engineering Department
Linear Systems, ECE 500, Section 002

COURSE SYLLABUS

In this Document…

Instructor Information…

Instructor: Chaouki T. Abdallah

Web site www.ece.unm.edu/faculty/chaouki
E-Mail: chaouki@ece.unm.edu

Phone: 505-277-0298

Fax: 505-277-1439
Office: EECE 112, ECE Building
UNM Main Campus

Office Hours: By appointment

Course Description

In this course, you will learn how to think about your engineering problems from a systems point of view. You will learn how to analyze and if needed to modify the behavior of systems. The course will concentrate on linear systems in the continuous and discrete time, but concepts learned in this course may be useful in the study of more complicated cases. Applications of the theoretical results presented will be investigated in a number of examples and problems.

This course will require a basic understanding of matrices, differential equations, Laplace transforms, and Z-transforms. Anyone with an undergraduate degree in Electrical Engineering from an accredited program should be equipped to handle the rigors of the course. I expect you to spend about 18 hours per week on the material covered in the course.

Return to top

Prerequisites

Since this is an online course, there are some minimum hardware and software requirements to complete the course. For recommended operating system requirements and web browser compatibility, see http://webct.unm.edu/home/setup/system.html.

For all browsers, JavaScript and cookies must be enabled. To use Chat and Whiteboard, Java must also be enabled. Please see http://webct.unm.edu/home/setup/browser.html for details on internet browser setups.

Students will need access to Microsoft Word and PowerPoint for this course. In addition, students will need to obtain WinZip and Adobe Acrobat Reader, which can be downloaded for free from the Internet.

Homework assignments will be submitted electronically via WebCT. Students will be expected to have access to a scanner for digitizing any handwritten assignments.

This course has the following academic prerequisites:

- Prerequisite 1: Graduate standing or consent of the instructor (course name and UNM course number)
- Prerequisite 2: EECE 314 (Signals & Communications), and Math 321 (Linear Algebra) or Math 464 (Applied Matrix Theory).

In addition to specific academic courses, students are expected to have familiarity with the following computer programs: **Matlab**. Please see "Using Matlab at UNM" under the resources icon in your course, to familiarize yourself with how to access UNM Matlab licenses on-campus and off-campus.

You will also need access to a fax or a scanner to submit handwritten homework assignments.

This course is available to full-time students and non-degree students attending part-time.

Return to top

Getting Started

In order to get oriented to this WebCT course, you should complete the following assignments in the order listed below:

1. WebCT Orientation – Start Here Button on the ECE 500 Homepage
2. Obtain the Matlab Software (if you do not have your own!)

If you are having technical problems with WebCT, you can contact free technical support through one of the following ways:

- Phone: (505) 277-7490
- Email: webct@unm.edu
- Web: http://webct.unm.edu

Any course content related questions should be directed to your assigned instructor. Please refer to contact information.

Return to top

Texts & Readings

PLEASE NOTE THAT THE FOLLOWING TEXTBOOKS HAVE GONE OUT OF PRINT. THEY ARE OT REQUIRED, BUT RECOMMENDED. Other recommended textbooks and resources are listed in Module 1 of the course.
1) A Linear Systems Primer, by P. Antsaklis and A. Michel, Birkhauser, 2007

You may choose to purchase your used textbooks via online resources such as http://www.amazon.com or http://half.com

Return to top

Policy

ALL ANNOUNCEMENTS/CHANGES/DUE DATES WILL BE POSTED ON WEBCT: IT IS THE STUDENT'S RESPONSIBILITY TO CHECK THEIR WEBCT ACCOUNT AND CALENDAR FOR COMMUNICATIONS AND CHANGES TO THE COURSE SEVERAL TIMES A WEEK. A GRADE OF ZERO WILL BE GIVEN FOR ASSIGNMENTS NOT COMPLETED BY THEIR DUE DATE. NO LATE ASSIGNMENTS OR QUIZZES WILL BE ACCEPTED.

Academic Integrity: Each student is expected to maintain the highest standards of honesty and integrity in academic and professional manners. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet these standards.

Access to Education: Qualified students with disabilities needing appropriate academic adjustments should contact the instructor as soon as possible to ensure your needs are met in a timely manner. For information on assistive technology available for student use and additional information on services available through Student Accessibility Services, see http://www.unm.edu/~sss/.

Audit: A student may register for a course as an auditor, providing permission of the instructor is obtained. A student has the first four weeks of the semester to change a course to audit status. No changes in audit status will be processed after the fourth week of class. Students are charged the normal tuition rate for auditing a course.

Collaboration: Collaborative work, such as studying or discussing course assignments and materials, with other class members is highly encouraged. Students are encouraged to collaborate with each other using the WebCT email discussion area tools. The discussion area called 'Student Café' is one place to share ideas with others in the class.

Copyright: All materials in this course fall under copyright laws and should not be downloaded, distributed, or used by students for any purposes outside of this course.

Exams: It will be the student's responsibility to arrange for proctoring for closed-book exams. Common locations include local libraries and Extended University branch

centers. Please contact New Media and Extended Learning at (505) 277-5765 for additional suggestions or assistance.

Office Hours & Contacting the Instructor: Office hours will be upon request. Generally, I am in my office between 10:00 AM and 3:00 PM daily. You may call me at (505)277-0298, or send me an email through WebCT email or to: chaouki@ece.unm.edu during normal Monday-Friday, 8-5 hours, and you can expect to receive an initial reply within 24 hours. Where appropriate, students are encouraged to post their questions to the discussion areas so that other students can benefit, and/or another student may be able to answer your question.

Privacy and WebCT Tracking Notice: WebCT or the course Web site automatically records all students' activities, including, your first and last access to the course, the pages you have accessed, the number of conferencing messages you have read and sent, chat rooms discussions, and posted discussion topics. This data is accessed by the instructor to evaluate class participation and to identify students having difficulty using WebCT features.

Incompletes, Withdrawals, and Drops: I give out incompletes only under extreme circumstances. If you are running into problems with the course, please contact me as early as possible so you do not fall behind.

This course falls under all UNM policies for last day to drop courses, etc. Please see http://www.unm.edu/studentinfo.html or the UNM Course Catalog for information on UNM services and policies. Please see the UNM academic calendar for course dates, the last day to drop courses without penalty, and for Financial Disenrollment dates.

Return to top

Assignments and Grading Criteria

This is an intensive, graduate-level course with regular and firm deadlines. As such, you should expect to spend at least 18 hours working on the course each week. This includes readings, viewing course content, completing homework assignments, posting to the discussion area, researching other material, etc.

Weekly Assignments

There will be three types of weekly assignments in this course, which are described below.

1. **Weekly Discussion Topics:** are, in essence the equivalent of "class participation" in this online course. The instructor will begin facilitation of these class discussions. Each discussion topic will last for approximately one-week, and sometimes more. Please log into the class and participate in the discussion at least twice during time window.

You are expected to participate in all of the discussion topics presented during the semester. You are encouraged to share your ideas, ask questions, and comment/ respond appropriately to other students' comments. The instructor will evaluate your discussion postings in terms of both quality and quantity as part of the course grade. **The weekly discussion will comprise 20% of the course grade.**

2. **Weekly Assignments:** Assignments will be posted approximately weekly. The total number of assignments will be approximately 10. These will not be graded, but you are encouraged to check the solutions provided to you.
    1. Total number assignments- approximately 10
    2. Open book
    3. Collaboration acceptable and encouraged
    4. Solutions will be posted in WebCT shortly after the assignment due date.
3. **Quizzes:** There will be bi-weekly quizzes (5 total) in a multiple-choice format, as well as mid-term exam. You may take each quiz only once. The quizzes closely follow the information presented in the WebCT lectures and the textbook.
    - Total number of quizzes – 5
    - Worth: 30% of grade.
    - Each quiz can be taken only ONCE, before the deadline
    - Open book and open notes
    - Collaboration unacceptable
    - Timed – Students will have 20-30 minutes to complete the quiz.

REMINDER about Late Submissions: All final dates for taking assignments and quizzes are posted on the course calendar and on the quiz page. You will receive zero points for any quiz or assignment not completed by the deadline.

Mid-term Exams: There will be 1 midterm exam as described above, worth 20% of the grade. Unofficial midterm grades will be posted so that the student understands her/his standing in the course. If for any reason, such grades are not posted, contact the instructor directly.

4. **Final Exam:** You will have an open-book final exam project in this course. This is similar to an extensive take-home exam. It will be open book, but NO collaboration is allowed. Please see the calendar for details on the date and form of this exam.
    - Worth : 30% of grade
    - Open Book, open notes, open anything

Final Grade	*Percent*
Discussion Postings	20
Midterm Exam	20
Biweekly Exams	30
Final Exam	30

EECE 500 Grading Structure, Fall 2009

Return to top

Course Evaluation

You will be asked to complete a mid-term and final course evaluation survey online for this course. These surveys are completely anonymous and provide useful information to improve this course for next semester's students. These surveys will be listed on the calendar and will appear in the quizzes section of the course. If you have any questions or concerns about the survey, please ask the instructor.

Return to top

Course Outline

Module 0: Introduction to WebCT

Objective: Become familiar with how to operate in the online WebCT environment & course policies. Go through the "Start Here" button on the course web site.

Module 1: Introduction & Overview of Control Theory

Objective: This chapter presents an overview of how systems are modeled and classified. It also includes a quick review of classical control methodologies and of various analytical design techniques.

The chapter also focuses on highlighting the limitations of classical (input/output) control system design. It also introduces various modeling approaches and definitions.

Module 2: Overview of Linear Matrix Algebra

Objective: This chapter reviews the needed mathematical concepts for studying linear systems. Review of matrix Algebra and matrix identities. It also serves to acquaint the student with concepts of linear Spaces and Operators, Eigenvalues and Eigenvectors. Properties of Matrices

QUIZ 1: Covers Modules 1 & 2

Module 3: State-Variable Systems

Objective: **This is a continuation of the previous chapter which makes the case for state-space designs, and discusses internal stability and the interpolation approach. To acquaint the student with the need of studying linear systems beyond the classical input/output (transfer function) approach, and to illustrate the benefits of using state-space for linear and nonlinear as well as continuous and discrete-time systems. Mathematical Description of Linear Systems: System Representation, State-variables and state-space representation. To introduce the student to various ways of obtaining state-space representations form input/output or transfer function realizations, and to discuss state-space transformations.**

QUIZES 2, 3: Cover Modules 1-3

Module 4: Structural Properties: Controllability, Reachability, Observability & detectability. BIBO & Lyapunov Stability

Objective: **To introduce the concepts of controllability and reachability for linear continuous-time and discrete-time systems. To introduce the concepts of observability and detectability for linear continuous-time and discrete-time systems. To introduce Bounded-input/bounded-output and internal (Lyapunov) stability concepts and tests. To explain the various stability concepts, and to provide tests in terms of eigenvalues and poles locations.**

MIDTERM EXAM: Covers 1-4

Modules 5, 6: Controller and Observer Design: State-feedback and output feedback.

Objective: **Design feedback controllers assuming the state is available. How to design full and reduced order observers for LTI systems Repeat of designs using input/output approach.** ***Design compensators using the interpolation and input-output framework.***

QUIZES 4, 5: CoversModules 1-6.

Module : 7Advanced Topics: LMI and others

Objective: **Introduce new tools to design LTI controllers.**

FINAL EXAM: Covers 1-6

END OF COURSE