EE555 Advanced Linear Systems (3 credits)
Spring 2005
Klipsch School of Electrical and Computer Engineering
College of Engineering
New Mexico State University

Instructor and Class Information

Instructor:	Dr. Phillip De Leon
	Goddard Annex 160G; (505) 646-DSP1 (3771); `pdeleon@nmsu.edu`
Date and Time:	Lecture: M, W, F 10:30 – 11:20am (T&B 307)
	Presentation Period: Th 3:50 – 5:50pm (T&B 307)
Office Hours:	M, W 3:00 – 4:00pm and by *prior* appointment

Course Description from the Graduate Course Catalog

Advanced level study of linear systems and associated mathematical theory including linear equations, spectral theory, normal matrices, projections, quadratic forms, discrete and continuous time dynamical systems.

Prerequisite

M480 Vector Spaces and Matrix Algebra or equivalent undergraduate Linear Algebra course.

Textbook and Other Required Materials

Required: *Advanced Linear Systems* by C. T. Mullis (available at Kinko's Copies, University Ave.)
Optional: *Matrix Analysis* by R. A. Horn and C. R. Johnson (available at NMSU Bookstore)
Optional: *Matrix Analysis and Applied Linear Algebra* by C. D. Meyer

Online Resources

EE555 Web Page
`http://www.ece.nmsu.edu/~pdeleon/Teaching/EE555/`

EE555 Email Distribution List
TO: `listproc@nmsu.edu`
BODY: `subscribe ee555 YOURFIRSTNAME YOURLASTNAME`

Course Objectives

The objective of this course is to provide students a solid foundation in linear algebra and matrix analysis—the language of Communications, Control, and Signal Processing theory. Such a foundation will greatly assist students in understanding research articles in journals such as the *IEEE Transactions on Communications* and *IEEE Transactions on Signal Processing* and also to conduct independent research. This objective is achieved through an advanced level

understanding of essential algebraic, structural, and numerical properties of linear equations and systems.

Contribution of EE555 to Meeting the Professional Component

Advanced Linear Systems is a core course for specialization in Communications Digital Signal Processing. Students in EE555 will practice and apply theory learned in class through assigned homework and in-class discussions. This will provide students with a broadening of their knowledge base in applying mathematical techniques to the 1) design and analysis of communications systems and 2) processing and analysis of signals; this will provide a basis for career employment. Discussion of design issues relate the class theory to practical societal issues. Class provides 3 credits of graduate credit.

Relationship of the Course to Program Objectives

Advanced Linear Systems provides a mathematical foundation for advanced level study in Communications, Digital Signal Processing, and Telemetering. This will allow students to further explore their graduate specialty and perform independent research.

Prepared

Phillip De Leon, February 3, 2005

Grading

Homework – There will be weekly assignments using problems chosen from the text (Mullis). Worth 30% of the final grade. It is expected these problems will be solved in cooperation with your peers and/or Prof. De Leon. Late homework is not accepted except in the case of an absence due to a medical or other very serious reason.

Presentations – There will be weekly presentations of individually selected problems chosen from the text (Mullis). The presentation problem with the lowest score will be dropped. Worth 20% of the final grade. It is expected that these problems will be solved on an individual basis with possible help from Prof. De Leon. Students will present their solution during a presentation period. Absence from presentation period is not accepted except in the case of a medical or other very serious reason.

Bonuses – Significant critique of presentations (pointing out incorrect assumptions or flaws in the proof) will be eligible for bonus points of up to 5% per incident up to a maximum of 10% of the final grade.

Exams – There will be mid-term and final exams during the semester testing knowledge of the subject material. Each exam is worth 25% of the final grade.

Policies

We highly encourage you to discuss homework problems (*not* problems for oral presentation) with your peers and Prof. De Leon. This discussion could include among other things, various approaches to a homework problem and various theoretical insights. Be aware however, that all submitted solutions to homeworks must be written by the individual. There is to be no "copying" of solutions. Evidence of peer cooperation or help for individual problems for oral presentations will result in a zero for the problem. *Any plagiarism or cheating will result in an automatic F in the course*.

Topics Covered

The topics covered are described in the Course Outline section of this syllabus.

Class Schedule

The class schedule is described in the Course Outline section of this syllabus.

EE555 Spring 2005 Course Schedule

Week 1 January 9, 2005

Determinants (1)

Week 2 January 16, 2005

Linear Equations (2)
January 17 MLK Day (no class)

Week 3 January 23, 2005

Matrix Rank, Range and Null Spaces (2)
Presentation Session #1

Week 4 January 30, 2005

Leverrier's Algorithm, Cayley-Hamilton (3)
Consequences of Cayley-Hamilton (4)
Presentation Session #2

Week 5 February 6, 2005

Spectral Representations (5)
Presentation Session #3

Week 6 February 13, 2005

Spectral Representations (5)
Presentation Session #4

Week 7 February 20, 2005

Spectral Theorem for Normal Matrices (6)
Presentation Session #5

Week 8 February 27, 2005

Spectral Theorem for Normal Matrices (6)
Exam #1 – 7:00 – 9:00pm Thu, March 3

Week 9 March 6, 2005

Projections and Resolutions (7) (brief)
Presentation Session #6

Week 10 March 13, 2005

Least-Squares, Singular Value Decomposition (8)
Presentation Session #7

Week 11 March 20, 2005

Spring Break!

Week 12 March 27, 2005

Singular Value Decomposition, Pseudoinverse (8)
Presentation Session #8

Week 13 April 3, 2005

Quadratic Forms (9)
Presentation Session #9

Week 14 April 10, 2005

Quadratic Forms (9)
Presentation Session #10

Week 15 April 17, 2005

Discrete-Time Lin Dynamical Systems (10)
Presentation Session #11

Week 16 April 24, 2005

Discrete-Time Lin Dynamical Systems (10)
Presentation Session #12

Week 17 May 1, 2005

Exam #2 – 10:30am – 12:30pm Fri, May 6