Department of Electrical Engineering
University of Southern California

EE 441 — APPLIED LINEAR ALGEBRA FOR ENGINEERING Spring 2012

Instructor: Urbashi Mitra, Professor
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Course Web Page: DEN Blackboard `www.uscden.net`
Contains homework, solutions, and relevant handouts. Course announcements, homework hints and modifications will be posted on this page – please check it regularly.

Lectures: TuTh 9:30-10:50 am, OHE 120

Discussion: F 1:00pm–1:50pm, OHE 120

Course Objectives: To provide a fundamental understanding of concepts and techniques of linear algebgra. The emphasis will be on developing the analysis and design tools needed to apply linear algebra to graduate electrical engineering courses and research.

Prerequisites: Calculus, undergraduate linear algebra and basic matrix theory.

Other Requirements: Basic computer skills (*i.e.* programming and plotting, familiarity with Matlab is helpful although not necessary.).

Text:
1. Linear Algebra and Its Applications, 4th ed., by Gilbert Strang, Thomson Learning Co., Belmont CA, 2006; ISBN-10: 0-03-010567-6.

Grading: (tentative) 20% Homework
35% Midterm (1.3 hours)
45% Final (2.0 hours)
Final grades will be assigned by a combination of student score distribution (curve) and the discretion of the instructor.

Exams: **Midterm** (tentative) Tuseday, March 6, 2012 9:30-10:50am
Final (fixed) Tuesday, May 8, 2012, 8:00-10:00am

Office Hours: TBA.
Use of email to set up appointments encouraged: ubli@usc.edu. Attending office hours in person is encouraged.

Late Policy: Homework is due at 5pm on Tuesdays in the 441 box (EEB 3rd floor). No late homework will be accepted. A late assignment results in a zero grade.

Make-up Material: Homework assignment dates are non-negotiable. Your lowest homework score will be thrown out before computing final grades. No make-up exams will be given. In the case of a required business trip or a medical emergency, a signed letter from your supervisor or doctor is required. This letter must include the telephone number of your doctor or supervisor.

Grade Adjustment: If you dispute any scoring of a problem on an exam or homework set, you have **one week** from the date that the graded paper is returned to request a change in the grade. After this time, no further alterations will be considered. All requests for a change in grade must be submitted in writing to me.

Attendance: Lecture attendance is encouraged; many examples and applications not in the text will be covered in the lectures. The student is responsible for all assignments, changes of assignments, announcements, lecture notes *etc.* All such changes should be posted on the course web-site.

Cheating: Cheating or plagiarism will not be tolerated on homework or exams. You may discuss homework problems among yourselves but each person must do their own work. Copying or turning in identical homework sets is cheating. The penalty ranges from 0 points on the homework or exam, to an F in the course, to recommended expulsion. See:

`http://www.usc.edu/dept/publications/SCAMPUS/gov/academic_integrity.html`

References:

1. Linear Algebra, 2nd ed., Kenneth Hoffman and Ray Kunze, Prentice-Hall 1971 (ISBN-10: 0135367972)
2. Matrix Analysis, Roger Horn and Charles Johnson, Cambridge University Press 1990 (ISBN-10: 0521386322)

Outline: (each item roughly corresponds to one week's material)

1. *Matrix operations, linear transformations*
   Review of matrix/vector operators such as addition, multiplication, *etc.*
2. *Solving simultaneous linear equations*
   (Elementary row operations, Gaussian elimination, by inversion, by determinants)
3. *Vector spaces*
   (Vectors in 2 and 3 dimensions, real vector spaces, abstract vector spaces)
4. *Subspaces*
   (Subspaces in general, subspaces of a linear transformation.)
5. *Linear independence, bases, and dimension*
   (Matrices in the solution of linear systems, dimension, all bases for the same vector space have the same cardinality)
6. *Linear transformations, projections*
7. *Orthogonality*
   Orthogonal vectors, orthogonality, normed vector spaces
8. *Least squares*
   (Orthogonal projections and least squares fitting, applications to data analysis)
9. *Orthogonalization and orthonormalization*
   (The Gram-Schmidt process, linear functionals, dual spaces and dual bases)
10. *Determinants*
    (determinant calculation, relation to linear transformations)

11. *Eigenvalues and eigenvectors*
    (Definition, significance, calculation of eigenvalues and eigenvectors)
12. *Similarity of matrices*
    (Definition, properties, and consequences of similarity; invariants under similarity transformation; similarity classes)
13. *Congruence transformations, diagonalization and invariants*
    (Invariants of congruence, reduction to "Congruence Normal Form,")
14. *Special matrices*
    (Symmetric, skew symmetric, orthogonal; Hermitian, skew Hermitian, unitary; stochastic, Hadamard, positive definite; diagonalization of Hermitian/Unitary matrices)
15. *Singular Value Decompositions and Quadratic Forms*
    (SVDs, pseudo-inverses, Rayleigh-Ritz Theorem)

Suggestions:

1. Remember the big picture.
2. Read the book and supplementary sources.
3. Prepare your own summaries from texts and notes.
4. Work in groups for homeworks and study (explain main concepts to each other, write up your own solutions).