Department of Electrical Engineering
University of Southern California

EE 241 — Applied Linear Algebra for Engineering

Instructor: Urbashi Mitra, Professor
536 EEB, 213 740 4667,ubli@usc.edu
Office Hours: Mondays 10am-11am; Tuesdays 11am - 12pm

TA: Celalettin Umit Bas, Ph.D. Student
515 EEB, 213 740 2338, cbas@usc.edu
Office Hours: Mondays 2-3pm, Thursdays 12:30pm -1:30pm

Course Objectives: Introduction to the theory of matrices, vector spaces, least-squares approximation and MATLAB. Applications to communications, control and signal processing.

Time and Location Lecture: MW 3:30-4:50, VHE 217; Discussion: F 3:30-4:20, KAP 140

Prerequisites: Math 126, EE 100 or equivalent

Other Requirements: Basic computer skills (*i.e.* programming and plotting, familiarity with Matlab).

Text: Introductory Linear Algebra, B. Kolman and D.R. Hill, 8th Ed.

References: Introduction to Scientific Computing (on MATLAB), C. F. Van Loan
Linear Algebra for Engineers and Scientists Using MATLAB, K. Hardy
Linear Algebra and Its Applications, 4th ed., G. Strang

Grading: 20% Homeworks
20% Midterm Exam 1, Wednesday, February 13, 2013
20% Midterm Exam 2, Monday April 1 or Wednesday April 3, 2013
40% Final Exam, Friday May 10, 2013, 2-4pm
Homework is assigned weekly, due one week after assigned. Some computer homeworks will be announced which will be due two weeks after assigned

Midterm Exams will be during the regularly scheduled lecture time on the dates indicated above. Exams are closed book, no calculators or computing devices. Prepared note sheets are allowed. Further details will be provided prior to the exams.

Disabilities: Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

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`

Outline:

Week	Subject	Text pages
1	Linear Equations and Matrices Linear systems, method of elimination Matrices: addition, transpose, and product.	Chapter 1 1-29
2	Solving a linear system of equations Reduced row echelon form, Gauss-Jordan method Homogeneous systems.	39-78
3	Application examples. Polynomial Interpolation example. Inverse of a matrix & related theorems and applications. Determinants. Permutations.	91-102 Chapter 3 182-185
4	Properties of determinant. Geometric significance of determinant. Expansion in cofactors. Inverse of a matrix. Examples.	186-207
5	Determinants from a computational point of view. Vectors in R^2 and R^n. Norm (Length or Magnitude). Using determinant to compute area. Angle between Vectors. Vector addition and scalar multiplication.	210-211 Chapter 4 214-226
6	Schwartz inequality. Triangle inequality. Linear transformations. Cross product in R^3.	229-254 Chapter 5 259-263
7	Lines and Planes in R^3.	264-269
8	Real vector spaces. Examples. Subspaces. Nullspace. Nullity.	Chapter 6 272-287
9	Linear combinations. Spanning. Linear independence. Basis. Dimension.	291-314
	Spring Break March 18-23, 2013	
10	Homogeneous systems. Row space. Column space. Rank. Coordinates and change of Basis.	317-342
11	Transition matrix. Orthonormal Bases Gram-Schmidt Orthogonalization.	343-358
12	Intersection, union, and sum of subspaces	

Week	Subject	Text pages
13	Orthogonal complements. Examples. Projections.	360-369
14	Eigenvalues and Eigenvectors. Characteristic equation. Similar matrices. The diagonal form of a matrix. Application to symmetric matrices.	Chapter 8 408-441
15	Least squares. Approximate solutions. Fitting.	Chapter 7 378-387

Learning Goals: After successfully completing this course, you should be able to:

- find all solutions (if any) to a set of linear equations, both by hand and using MATLAB;
- completely understand matrix manipulations;
- find the determinant and inverse of a matrix;
- take inner products between vectors;
- know the definition of a vector space;
- know the definition of a linear map;
- find a basis for a vector space or subspace;
- find an orthonormal basis for a vector space or subspace;
- find the projector and orthogonal complement of a subspace;
- find a matrix representation of a linear map;
- identify the range, nullspace, rank, and nullity of a linear map;
- solve for the eigenvalues and eigenvectors of a matrix, and diagonalize matrices;
- approximate solutions using least squares.

You should be able to apply linear algebra to:

- problems in probability;
- fitting polynomials to data;
- analyzing graphs and networks;
- performing geometric transformations in two and three dimensions;
- doing compression and error correction of data;
- extracting signals from noisy data;
- solving linear ordinary differential equations.