

## Math 545 (36097) - Linear Algebra for Applied Mathematics - FALL 2011

TuTh 1:00 → 2:15 LGRC A201

**Professor:** Eyal Markman

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**Course Web page:** <http://www.math.umass.edu/~markman/> **Please check it often!**

**Office hours:** (tentative) Tuesday 5:00 → 6:00 pm, Thursday 3:00 → 4:00 pm, and by appointment.

**Prerequisites:** Math 233, Math 235, Math 300.

**Text:** The main text will be:

*Linear Algebra. An introductory approach*, by C. W. Curtis, Corrected reprint of the 1984 fourth edition. Undergraduate Texts in Mathematics. Springer-Verlag, New York, 1993.

**Description:** In spite of its name, this is simply a second course in linear algebra, intended for undergraduates as well as graduate students (in such fields as mathematics, statistics, physics, engineering, etc. . .) who need to use linear algebra. The aim is to get a deeper knowledge of both concepts and techniques. Students in this course will need to write proofs (hence the math 300 prerequisite).

**Homework:** Will be assigned weekly and will be due each Thursday, unless mentioned otherwise. The homework will be graded by a special grader. Due to lack of funds, it will not be possible to grade all the homework problems assigned. A few of the homework problems will be corrected and graded every week. Nevertheless, for your own benefit, you will be asked to hand in *all* the homework problems assigned. Your grade on each homework assignment will be calculated as follows:

70% The grade on the corrected problems.

30% Credit for handing in *most* of the homework problems assigned. Partial credit will be given.

Late homework will not be collected. Instead, your three lowest grades will be dropped.

**Grades:**

Homework—20%

Two Midterms—50% (each 25%)

Final Exam—30%

**First Midterm:** Thursday, October 13, during class period.

**Second Midterm:** Thursday, November 17, during class period.

**Final:** During the week beginning Monday, December 12 and ending on Monday, December 19. The precise date is yet to be determined.

**See back . . .**

**Homework Assignment 1:** Due: Thursday, September 15 (a two weeks worth of homework!) **Justify all your answers!!!**

1. Read Sections 2, 3, 4, 5, 6, 7, 8, 9, 11 (Review of material from math 235)
2. Section 2 page 15: 2 (a), 4
3. Section 3 page 25: 6, 9, 10
4. Section 4 page 33: 3 (b), (c), (g), (h), (Justify your answer by verifying the conditions in definition 4.1), 4 (f), (g), 7, 9
5. Section 5 page 37: 3, 5
6. Section 6 page 48: 3 (e), 4, 5 (a)
7. Section 7 page 52: 1, 5, and the following problem. Let  $S$  and  $T$  be both three dimensional subspaces of  $R_4$ . What are all the possible dimensions of  $(S \cap T)$ ?
8. Section 9 page 68: 1, 4 (a), (c)
9. Section 11 page 87: To be announced. Check the web page for updates.

**Syllabus:**

1. A brief review of basic linear algebra. (Corresponding to the first nine Chapters of Curtis, most of which will be assumed as prerequisite).
2. The theory of a single linear transformation.
  - (a) Eigenvalues, eigenvectors, characteristic polynomial
  - (b) Minimal polynomial
  - (c) Invariant subspaces, direct sums
  - (d) Primary decomposition
  - (e) Diagonalizable operators
  - (f) Triangular form, Cayley-Hamilton Theorem
  - (g) Rational and Jordan canonical form
3. Orthogonal and Unitary transformations
  - (a) The Gram-Schmidt process
  - (b) The structure of orthogonal transformations
  - (c) The Principal Axis Theorem
  - (d) Unitary transformations and the Spectral Theorem
4. Further topics and applications (selection among the following):
  - (a) Systems of first order linear differential equations
  - (b) The QR-algorithm for eigenvalues
  - (c) Least square solution of a linear system
  - (d) Singular value decomposition
  - (e) Other applications, depending of time constraints and class preference.