Introduction to Linear Algebra for Engineers
Fall Semester 2008

Instructor: Yehonathan Hazony, Professor of Manufacturing Engineering.

The course combines linear algebra with analytical geometry in the context of computer-aided engineering design, analysis and manufacture. Engineering-geometry serves to introduce linear algebra. Mathematical abstraction is linked to practical engineering-graphic applications. Tools of linear algebra are introduced to facilitate the analysis of engineering designs, as well as for the preparation of design data for the transformation to computer-controlled manufacture. Eigen Values and Eigen Vectors are introduced in the context of engineering-problem solving.

Credit: 2 cr. Either semester
Cannot be taken in addition to CAS MA142 or MA 242..

Textbooks:
Elementary Linear Algebra - Bernard Kolman, and David R. Hill,


Grading: 3 tests (1-hour) – 25 points each (only the better two grades count)
Final Exam (2 hours) – 50 points (to be scheduled by the college)

Topics:

1. Introduction - Linear algebra as a fundamental tool for engineering.
2. Linear Equations and Matrices (Textbook Section 1.1 – 1.6)
   Linear equations in 2- and 3-dimensional spaces.
   Points, lines and planes.
3. Scalars, Vectors and Matrices: (Sections 1.2-1.4, 2.1 and 3.1)
   Matrix operations, (Section 1.2)
   Dot-Product and the Inner-Product (Section 1.3, 2.1 and 3.1)
   Outer-Product (Section 1.8 - page 82)
   Matrix equations.
4. Solutions of linear systems of equations (Section 1.5)
   Geometric space,
   Coefficient space,
   The Gauss Method,

Test #1 – Wed. – Oct 1st 08
5. The inverse of a matrix: (Sections 1.4 - 1.6)
   An invertible (non-singular) matrix
   A computational definition
   A formal definition.
   LU-decomposition method.

6. Singular (non-invertible) systems (Sections 1.1, 1.4, 1.6, and Chapter 2)
   Span and linear independence (Section 2.4)
   Homogeneous systems (Sections 1.1, 2.3, 2.4, and 2.6)
   Rank of a matrix (Section 2.8)
   Trivial and nontrivial solutions. (Section 1.1)
   Parametric solutions. (Section 2.3)

7. Determinants: (Chapter 5)
   Definitions and properties (Section 5.1 and 5.2)
   Cofactor expansion and application (Section 5.3)
   A computational point of view (Section 5.6).

Test#2 - Monday Nov. 3rd 08

8. Vectors in \( \mathbb{R}^n \) and Inner-Product spaces (Chapter 3)
   n-vectors and dot-product spaces (Sections 3.1 and 3.3)
   Coordinate systems and change of bases (Sections 2.5 and 2.7)
   Orthogonal and orthonormal bases (Section 3.5)
   The Gram-Schmidt Process (Section 3.4)
   Over constraint-systems, normal systems and
   Least-mean squares (Section 3.6)

9. Linear transformations and Transformation Matrices (Sections 4.1 and 4.3)

10. Quadratic forms and the Eigen-Value problem: (Sections 6.6-6.8)
    Definitions
    Principal Axes
    The Eigen-Value problem

11. Solution methods: (Sections 6.1, 6.4)
    Eigen Values
    Eigen Vectors and Orthogonal Transformations

Test #3 Mon. Dec. 8-th 08
Final Exam - to be scheduled by the College.