

# Departmental Syllabus

(A guide for MATH 349 instructors)

**Text:** Poole, David, *Linear Algebra: A Modern Introduction*, 2nd Ed., Thomson, 2006, ISBN: 0-534-99845-3.

## Core Topics

- 1. Review of Vectors** (Sections 1.1 – 1.3):  
Vectors in  $R^3$  and in  $R^n$ , dot product, length, lines and planes.
- 2. Systems of Linear Equations** (Sections 2.1 – 2.3)  
Linear Systems, row operations, echelon and reduced row echelon forms, Rank Theorem, concepts of span and linear independence.
- 3. Matrices** (Sections 3.1 – 3.3, 3.5, 3.6):  
Matrix operations, matrix algebra, partitioned matrices, inverse. Subspaces, basis, dimension, rank, introduction to linear transformations.
- 4. Eigenvalues and Eigenvectors** (Sections 4.1 – 4.4):  
Concept of eigenvalue and eigenvector, determinants, Cramer's rule, similarity and diagonalization.
- 5. Orthogonality** (Sections 5.1 – 5.4, 7.1, 7.3):  
Orthogonal bases, orthogonal matrices, orthogonal projection, fundamental subspaces of a rectangular matrix, Gram-Schmidt Process, diagonalization of symmetric matrices. Least squares approximation.
- 6. Vector Spaces** (Sections 6.1, 6.2, 6.4, 6.5):  
Vector spaces and subspaces, basis and dimension, linear transformations, kernel and range of a linear transformation.

**7. Computer Computations:**

Using one of the software package such as Magma, Maple, Matlab to solve systems of equations, compute determinants, eigenvalues and eigenvectors of square matrices, least squares, etc.

**Additional Topics (if time permits)**

**LU-factorization** (Section 3.4)

**Matrix representation and change of basis for linear transformations**  
(Sections 6.3 and 6.6)

**Positive definite matrices and quadratic forms** (Section 5.5)

**Singular value decomposition** (Section 7.4)