

Matrix Analysis – (Advanced Linear Algebra) Math5150

Preliminary Syllabus, Spring 09 (Graduate Course)

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- **Course Description and Objective:**

Research in the areas of applied mathematics and scientific computation often encounters matrix analysis and computation problems. In this course you will learn advanced techniques and tools in matrix theory, linear algebra and its applications. This course will help do better research in the related areas. **The instructor will provide you all the class materials.**

- **Textbook:** Roger A. Horn and Charles R. Johnson, “Matrix Analysis”, Cambridge University Press, 1994 (Reprint)

- **Credit Number:** 3

- **Prerequisites:** Calculus, Elements of Linear Algebra

- **Expected Work:** Homework (= 1/3); One midterm exam and Final project(= 2/3).

- **The Covering Topics:**

1. *Review and Miscellanea:* Matrices, Determinants, Vector spaces, Special types of matrices, Inner Products etc..
2. *Eigenvalues, Normal Matrices:* Characteristic polynomials, Eigenvectors, QR factorization algorithm, Hermitian matrices, Norms;
3. *Positive Definite Matrix* (Hermitian and non-Hermitian): Definitions and examples, Properties and Characterizations, The polar form and singular value decomposition, The Schur product theorem, Inequalities;
4. *Nonnegative Matrices:* Definitions and examples, Irreducible matrices, Perron-Frobenius theorem, and M -matrices;
5. *Matrix Functions:* Polynomial matrix functions and interpolations; Non-polynomial matrix functions; Hadamard matrix functions; Square roots, Logarithms, Nonlinear matrix equations; A chain rule for functions of a matrix.

- **References:**

1. Roger A. Horn and Charles R. Johnson, “Topics in Matrix Analysis”, Cambridge University Press, 1999.
2. G. Golub and C. VanLoan, “Matrix Computations”, Johns Hopkins University Press, Baltimore, Third Edition.