

Course Title and Number: MATH 434/534 - Numerical Linear Algebra

Course Description: Crosslisted as CSCI 434X. Roundoff errors and computer arithmetic. Direct and iterative methods for solving linear systems; norms and condition numbers, iterative refinement. Linear least squares problems: the normal equations and QR approach for overdetermined systems. Numerical methods for eigenvalues: an introduction to the QR iteration. The course makes extensive use of computers.

PRQ: MATH 232, either MATH 239 or MATH 240, and either CSCI 230 or CSCI 240 or approved equivalent.

Course Objectives:

- To reason rigorously in mathematical arguments.
- To communicate mathematics clearly and efficiently.
- To understand the subtlety of numerical computation.
- To obtain facility in the use of technology as applied to mathematical problems.

Content:

- Floating point numbers and errors in computation.
- Stability of algorithms and conditioning of problems.
- Numerical solutions of linear systems.
- Numerical solutions of linear least-squares problems.
- Numerical solutions of matrix eigenvalue problems.

Course Requirements: Discussion of new tools and strategies in problem solving. View problems from multiple viewpoints emphasizing numerical approaches. Solution of more advanced problems, and discussion of depth in mathematics. Use the computer in solving substantial problems. Read and write about numerical approaches to concepts and connections within mathematics and in other disciplines. Regular homework involving both computer and non-computer work. Hour examinations. Final examination.

Assessment Instruments: Judgment on student involvement and depth of contributions in class discussions. Computer project work. Homework problem solutions. Hour exams. A final examination.

Selective Bibliography:

- Ascher and Grief, **A First Course in Numerical Methods**, SIAM (2011).
Datta, **Numerical Linear Algebra and Applications**, 2nd ed., SIAM (2010).
Trefethen and Bau, **Numerical Linear Algebra**, SIAM (1997)
Watkins, **Fundamentals of Matrix Computations**, 3rd ed., Wiley (2010).