

AMSC/CMSC 666 - Section 0101 (Fall 2002)  
**NUMERICAL ANALYSIS I**  
MTH 0106 - TuTh 11-12:15

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Office Hours: Mo 2-3, Th 10-11 (or by appointment)  
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**Objectives:** This course is an introduction to four basic topics in numerical analysis. We will discuss statement and properties of mathematical problems, numerical algorithms for their solution, and examine crucial issues such as domains of applicability, stability, rates of convergence, and computational complexity.

### Course Outline

1. Interpolation and Approximation Theory (6 weeks)
  - Lagrange interpolation, Newton form, divided differences
  - Error analysis, Chebyshev polynomials, Jackson Theorem
  - Uniform approximation, Weierstrass's Theorem and Bernstein polynomials
  - Piecewise polynomial interpolation (Lagrange and Hermite), cubic splines, error analysis
  - Least squares, normal equations, orthogonal polynomials, QR factorization, singular value decomposition
2. Quadrature (2 weeks)
  - Peano Kernel and Euler-MacLaurin expansion
  - Extrapolation and Romberg integration
  - Adaptive quadrature
  - Gaussian quadrature
3. Iterative Methods for Linear Systems of Equations (4 weeks)
  - Classical methods: Jacobi, Gauss-Seidel, SOR, convergence
  - Krylov sequence methods, conjugate gradient method, GMRES, preconditioning, convergence.
4. Eigenvalue Problems (3 weeks)
  - Similarity transformations
  - Rayleigh quotients
  - Power and inverse power methods
  - Householder transformations
  - QR algorithm, shift and deflation, convergence
  - Singular value decomposition.

**Grading Policy:** Course grades will be based on homeworks (40%), 2 midterm exams (15% each) and a final exam (30%). The exams will most likely be during the weeks of October 22 and December 3. The final exam will be on Monday, Dec 16, 8-10AM.

**Homeworks:** They will consist of several problems to develop by hand (or word processor) and a few computing problems (projects). They will be mostly theoretical, with about 20% of computations using MATLAB. Homeworks must be neatly written and in correct English sentences. Late homework will receive a penalty of 10% for up to 2 weekdays late, and 20% for up to 5 weekdays late. Homeworks which are overdue for more than 5 weekdays will not be accepted. Homeworks, deadlines, and other course material, will be posted at the website

<http://www.math.umd.edu/~rhn>

A useful elementary introduction to MATLAB by J. Cooper is found at <http://www.math.umd.edu/~jec>

## References

- J. Stoer and R. Bulirsch, *Introduction to Numerical Analysis*, Springer-Verlag, New York, 1993; ISBN 3-540-97878-X.
- A. Quarteroni, R. Sacco, and F. Saleri, *Numerical Mathematics*, Springer-Verlag, New York, 2000; ISBN 0-387-98959-5.
- K. Atkinson, *An Introduction to Numerical Analysis*, Wiley, 1989.
- C. de Boor, *A Practical Guide to Splines*, Springer-Verlag, 1978.
- P.J. Davis, *Interpolation and Approximation*, Dover, 1975.
- G. Golub and C. van Loan, *Matrix Computations*, Johns Hopkins University Press, 1989.
- G.W. Stewart, *Afternotes goes to Graduate School*, SIAM, 1998.