AMSC 667 (Spring 2011)

NUMERICAL ANALYSIS II

Tu-Th 9:30-10:45, MTH 1308

INSTRUCTOR

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COURSE OUTLINE

This course deals with numerical methods for initial value problems for ordinary differential equations and boundary value problems (mostly in 1D), and iterative methods for linear algebraic systems of equations and eigenvalue problems. Each of these parts will take 3-4 weeks.

1. Numerical Methods for Initial Value Problems

- Runge-Kutta methods
- Multistep methods
- Consistency, stability and convergence analysis
- Error estimation and stepsize control
- Methods for stiff systems

2. Numerical Solution of Boundary Value Problems

- Two-point boundary value problems
- Finite difference methods
- Variational formulation and the finite element method
- Introduction to error analysis
- Discretization methods for multidimensional problems

3. Iterative Methods for Linear Systems

- The conjugate gradient method for symmetric positive-systems
- Preconditioning techniques and relation to splitting methods
- Application to boundary value problems
- Convergence analysis
- Multigrid
- Krylov subspace methods for indefinite and nonsymmetric systems

4. Eigenvalue Methods

- Similarity transformations
- Rayleigh quotients
- Power and inverse power methods
- QR algorithm
- Lanczos method
- Arnoldi method

TEXTS

J. Stoer and R. Bulirsch, *Introduction to Numerical Analysis*, Springer, 1980.
G.W. Stewart, *Afternotes goes to Graduate School*, SIAM, 1998.
G. Golub and C. van Loan, *Matrix Computations*, Johns Hopkins University Press, 1989.
L.F. Shampine, *Numerical Solution of Ordinary Differential Equations*, Chapman and Hall, 1994.

EVALUATION POLICY

There will be about 5 HOMEWORKS which will amount to 50% of the final grade. The homeworks will be about 80% theoretical and 20% computational using MATLAB. There will be a penalty of 10% per day late; homeworks will not be accepted after one week. There will be a MIDTERM exam tentatively on March 10, which will amount to 20% of the grade. The FINAL exam will be comprehensive and will constitute 30% of the grade.