Syllabus for Comprehensive Examinations

NUMERICAL ANALYSIS

M.S. - MATH

1. **Numerical Linear Algebra**
   - i) Direct solution of linear systems: Gauss and Gauss-Jordan elimination, LU decomposition, operation counts, roundoff error.
   - ii) Iterative solution of linear systems: Jacobi, Gauss-Seidel, and SOR iteration; convergence of general iterative methods.
   - iii) Eigenvalue/eigenvector problems: the power method, the QR method.
   - iv) Theoretical considerations: nullspace, column space, rank, similarity transformations, orthogonalization.

2. **Numerical Solution of PDEs**
   - i) Elliptic equations: existence and uniqueness of solutions, finite-difference approximations, consistency and convergence.
   - ii) Parabolic equations: finite-difference approximations, explicit and implicit methods, consistency, stability, convergence.
   - iii) Hyperbolic equations: finite-difference approximations, the method of characteristics for first and second order, the CFL condition.

REFERENCES

[1] Strang, *Linear Algebra and It's Applications*, 3rd. ed.

[2] Smith, *Numerical Solutions of Partial Differential Equations: Finite Difference Methods*, 3rd. ed.

[3] Young and Gregory, *A Survey of Numerical Analysis*.
(Vol. II -- Chapters 11, 12, 14, 15, 16, 17)

OTHERS

[4] Morton and Mayers, *Numerical Solution of Partial Differential Equations*.
(Except Chapter 3)

[5] Fox, *An Introduction to Numerical Linear Algebra*.

GSC reviewed
3/12/98