

**Cal State LA Department of Mathematics**  
**Syllabus for MS Comprehensive Examinations**  
**NUMERICAL ANALYSIS**

**1. Numerical Linear Algebra**

- i) Direct solution of linear systems: Positive definite matrices and Cholesky Factorization, LU decomposition; Gaussian elimination with pivoting and Gauss-Jordan elimination, operation counts, round-off 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, inverse power method and Rayleigh Quotient technique; the QR method; convergence considerations and orders of these methods.
- iv) Relevant theoretical considerations: Properties of matrices including norms and condition number, eigenvalue, eigenvectors, null-space, column space, rank, similarity transformations, and Gram-Schmidt orthogonalization.

**REFERENCES**

- Math 570 Textbook: Watkins, D., Fundamentals of Matrix Computations, 3<sup>rd</sup> edition.
- Pre-requisite Math 470 textbook: Epperson, J., An Introduction to Numerical Methods and Analysis, 2<sup>nd</sup> edition
- (Suggested reading) Linear Algebra textbook: Strang, G. , Linear Algebra and Its Applications, 4<sup>th</sup> edition

**2. Numerical Solution of PDEs**

- i) Parabolic equations: finite-difference approximations, explicit and implicit methods, consistency, stability, convergence.
- ii) Hyperbolic equations: finite-difference approximations, explicit and implicit methods, the method of characteristics and numerical integration for first and second order; the CFL condition; consistency, stability, convergence.
- iii) Elliptic equations: existence and uniqueness of solutions, Maximum principles, finite-difference approximations, consistency and convergence.

**REFERENCES**

- Math 571 Textbook: Smith, G.D., Numerical Solutions of Partial Differential Equations: Finite Difference Methods, 3<sup>rd</sup> edition.
- Pre-requisite Math 470 textbook: Epperson, J., An Introduction to Numerical Methods and Analysis, 2<sup>nd</sup> edition
- (Suggested reading) PDE textbook: Strauss, W., Partial Differential Equations: An Introduction, 2<sup>nd</sup> edition.