

This is not an exhaustive list, but a summary of what you should review or study. The final will be based on material in Trefethen Lectures 1–17, 20–28 focusing on material covered in lecture and homework. Additionally the summary ODE lecture notes posted on the website.

You may use 3 full sheets (6 fronts and backs) of notes.

NO COMPUTERS OR CALCULATORS! USE OF MATLAB = F.

Summary of Topics

1. Pre-Midterm Material: see MidtermTopicSummary.pdf posted on website.
2. Gaussian Elimination
 - Relation to LU factorization
 - Partial Pivoting and relation to LU factorization
 - Solving the square system $Ax = b$ using LU factorization with pivoting. (*i.e.* forward and back substitution)
 - Cholesky factorization (when is it used?)
3. Eigenvalues
 - Meaning of eigenvalues, eigenvectors, algebraic multiplicity and geometric multiplicity.
 - Meaning of normal, and defective matrices.
 - Connection between normal matrices, defective matrices and eigenvalue decompositions of matrices.
 - Meaning of the Schur factorization.
 - Power, Inverse Power with shifts, Rayleigh quotient iteration, for real symmetric matrices.
 - Reduction to Hessenberg form
 - Basic idea of QR algorithm. (Algorithm 28.1 and 28.3 and Theorem 28.3.(not the proof, just the basic idea.))
4. ODEs (Lecture notes posted on the website is what you should consult. Here is a summary:)
 - Problem stability
 - Basic Linear Multistep Methods: Forward and Backward Euler, Trapezoid and Midpoint.
 - Explicit vs. Implicit schemes.
 - Root solving using Newton iteration, and connection to implicit schemes.
 - Global error
 - Truncation error and consistency
 - Convergence (definition and idea).
 - Numerical stability (Absolute stability). What do absolute stability regions imply about the numerical solution.
 - Connection between problem eigenvalues, absolute stability and choice of numerical method.