Mathematical and Computational
Methods for Engineers

ME200C
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Handout 2

Topics in Numerical Analysis

1. INTERPOLATION

   Lagrange Polynomials
   Polynomial Interpolation; Splines

2. NUMERICAL DIFFERENTIATION

   Construction of finite difference schemes, order of accuracy
   Modified wavenumber as a measure of accuracy
   Padé approximation
   Matrix representation of finite difference schemes

3. NUMERICAL INTEGRATION

   Trapezoidal rule; Simpson's rule; error analysis and mid-point rule
   Romberg Integration and Richardson's extrapolation
   Adaptive quadrature; Gauss quadrature

4. NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

   Initial value problems; Numerical stability analysis, model equation
   accuracy; phase and amplitude errors
   Runge-Kutta type formulas, multi-step methods; implicit methods
   system of differential equations, stiffness
   linearization for implicit solution of non-linear differential equations
   boundary value problems, shooting, direct methods, non-uniform grids,
   eigenvalue problems

5. PARTIAL DIFFERENTIAL EQUATIONS

   Classification of partial differential equations; finite-difference solution of
   partial differential equations
   Modified wavenumber and Von Neumann stability analysis, modified equation analysis
   Alternating Direction Implicit methods; non-linear equations; iterative
   methods for elliptic PDE's