

## Departmental Syllabus **Math 3730 -- Numerical Analysis**

**Textbook:** *Applied Numerical Analysis* (Sixth Edition), by Curtis Gerald and Patrick Wheatley

**Prerequisites:** MATH 3230 and fluency in a programming language

**Calculators:** No specific calculator required.

**Course Description:** This course is intended to provide an introduction to numerical methods. Topics will include computer arithmetic, solving nonlinear equations, numerical linear algebra, interpolation and curve fitting, numerical calculus, and numerical solutions of ordinary differential equations. Other topics may be added as time permits.

**Topics and sections to be covered:**

**Chapter 0: Review**

- Calculus Review
- Taylor's Theorem
- Computer Arithmetic

**Chapter 1: Solving Nonlinear Equations**

- Bisection Method
- Secant Method
- Linear Interpolation (Method of False Position)
- Newton's Method
- Muller's Method
- Fixed Point Iteration
- Convergence and Accelerating Convergence
- Error Analysis

**Chapter 2: Solving Systems of Equations**

- Some Basic Algorithms from Linear Algebra
- Efficient Algorithms and Economical Storage
- Flops Count
- Solving Upper Triangular (Lower Triangular) Systems
- Gaussian Elimination and  $LU$  Factorization
- Gaussian Elimination with Partial Pivoting
- Householder Reduction and  $QR$  Factorization
- Factoring  $A = LU$  Using Direct Methods
- Existence and Uniqueness
- Stability and Conditioning

**Chapter 3: Interpolation and Curve Fitting**

- Lagrangian Polynomials
- Neville's Method
- Divided Differences
- Interpolating with a Cubic Spline
- Error Analysis

**Chapter 4: Numerical Integration**

- Trapezoidal Rule
- Simpson's Rule
- Higher-Order Rules
- Gaussian Quadrature
- Error Analysis

**Chapter 5: Numerical Solutions to Ordinary Differential Equations**

- Taylor-Series Method
- Euler's Method
- Modified Euler Method
- Runge-Kutta Methods
- Error Analysis