Math 350 – Introduction to Computational Mathematics

Course Description from Bulletin: Study and design of mathematical models for the numerical solution of scientific problems. This includes numerical methods for the solution of linear and nonlinear systems, basic data fitting problems, and ordinary differential equations. Robustness, accuracy, and speed of convergence of algorithms will be investigated including the basics of computer arithmetic and round-off errors. Same as MMAE 350. (3-0-3). (C)

Enrollment: Required for AM and elective for other majors.

Textbook(s): Cleve Moler, *Numerical Computing with MATLAB*, SIAM.
S. C. Chapra & R. P. Canale, Numerical Methods for Engineers, 6th Edition, McGraw Hill, 2009.

Other required material: MATLAB or Mathematica

Prerequisites: MATH251, MATH 252, and CS 104, 105 or CS 115, or consent of instructor

Objectives:

1. Students should gain an appreciation for the role of computers in mathematics, science and engineering as a complement to analytical and experimental approaches.
2. Students should have a basic knowledge of numerical approximation techniques, know how, why, and when these techniques can be expected to work, and have ability to program simple numerical algorithms in MATLAB or other programming environments.
3. Students should have learned what computational mathematics is about: designing algorithms to solve scientific problems that cannot be solved exactly; investigating the robustness and the accuracy of the algorithms and/or how fast

- review of Taylor series
- numerical error (floating-point representation, computer arithmetic, round-off errors, and loss of significance in numerical computations)
- programming in MATLAB

2. Locating Roots of Equations 6
   - bisection method
   - Newton's method
   - secant method
   - introduction to the solution of systems of nonlinear equations
     - Newton's method for systems
3. Solving Systems of Linear Equations 6
   - direct methods (LU factorization)
   - basic iterative methods (Jacobi, Gauss-Seidel and SOR)
4. Interpolation 6
   - polynomial interpolation
   - piecewise polynomial and spline interpolation
5. Numerical Integration 4
   - Newton-Cotes methods
   - adaptive quadrature
6. Numerical differentiation and solution of ordinary differential equations 10
   - finite differences
   - Runge-Kutta methods
   - multistep methods and stiff equations (comparison of various MATLAB stiff solvers)
   - FFT and spectral methods

Assessment:	Homework	10-30%
	Computer Programs/Project/Presentation	10-20%
	Quizzes/Tests	20-50%
	Final Exam	30-50%

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