MAE 495/589, Computational Methods in Engineering  
Fall 2018  
Course Outline

Instructor  
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Office hours: 9:30 am-11:45am Mondays and Wednesdays  
Open Door Policy other times or by appointment

Schedule  
1:30pm-2:45pm Mondays and Wednesdays  
2236 Engineering Building III

Prerequisites  
MA242, MA341, and CSC112/113. Knowledge of a computer programming language, linear algebra, and differential equations.

Programming Languages  
You need to write your own computer programs using a computer programming language you know for homework assignments, projects, and exams. Examples of the programming languages are: Matlab, Fortran, C/C++, Java, etc. Unless stated otherwise in the assignments, hand calculations or spreadsheet (such as MS Excel) calculations are not considered as computer programs and are not allowed.

Course web page  
http://people.engr.ncsu.edu/hluo2/courses/mae495/index.html

Reference books (no preferred order)  

Course overview

- Chapter 1. Introduction, Computer Arithmetic, and Computational Errors (approx. 4 lectures)  
  - Introductory concepts and some mathematical preliminaries  
  - Computer arithmetic  
  - Computational errors  
  - Stability and conditioning

- Chapter 2. Solving Systems of Linear Algebraic Equations (approx. 5 lectures)  
  - Motivation  
  - Gaussian elimination  
  - Well-conditioning vs. ill-conditioning, matrix and vector norms sparse systems:
• Direct methods
• Iterative methods

• Chapter 3. Interpolation and Data Fitting (approx. 6 lectures)
  • Motivation
  • Polynomial interpolation
  • Piecewise polynomial interpolation
  • Spline interpolation
  • Linear least squares fitting

• Chapter 4. Numerical Calculus (approx. 4 lectures)
  • Motivation
  • Numerical Differentiation
  • Numerical Integration

• Chapter 5. Solving Nonlinear Systems of Equations (approx. 3 lectures)
  • Motivation
  • Bisection, Newton’s method, and secant method methods for systems of equations

• Chapter 6. Numerical Methods for Ordinary Differential Equations (approx. 4 lectures)
  • Motivation
  • Ordinary differential equations and Euler’s method adaptive methods for ordinary differential equations methods for stiff systems

Objectives
To provide students with necessary tools for numerical solutions of engineering problems. By the end of this course, the students should be able to solve problems involving:
  • Solution of linear systems of equations
  • Data fitting and interpolation
  • Solution of nonlinear systems of equations
  • Numerical differentiation and numerical integration
  • Solution of ordinary differential equations

Assignments, Grading, Projects, Attendance, etc.
• Approximately 6-8 homework assignments will be handed out. They will need to be completed in 1-1.5 weeks as per the deadline provided in the homework. Late homework will not be accepted. (20%)
• In-class midterm examination is tentatively scheduled on Wednesday, October 10, 2018. (20%)
• Class attendance is not required. However, pop quizzes might be given at the beginning or at the end of classes. No make-ups for pop quizzes. (5%)
• Project: One project will be assigned. Subject and dates to be decided (TBD). (25%)
• A comprehensive final examination on Friday, December 14, 2018, 1:00pm-4:00pm. (30%)
• Attendance compulsory on all examinations. No make-up examinations except for a certified medical reason.
• Academic dishonesty will not be tolerated and will be dealt with as per the NCSU Code of Student Conduct. The Honor Pledge: “I have neither given nor received unauthorized aid on this test or assignment” will be in effect for all homeworks, exams, and computer project.
• Email will frequently be used for sending messages to students regarding coursework.