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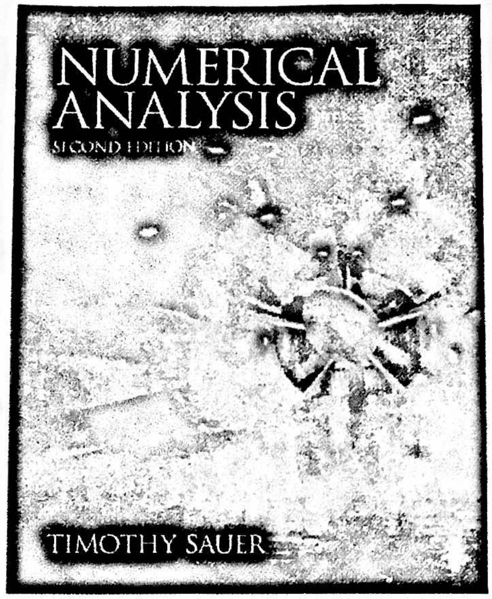

Numerical Analysis II

Math 447 Section 001 / CDS 410 Section 002
4107 Exploratory Hall
SPRING 2018

TR 10:30 - 11:45

Instructor: Tim Sauer
Office: 4209 Exploratory Hall
Hours: TR 1:30 - 3 pm
Phone: 703 993-1471
Email: tsauer@gmu.edu
Web Page: http://math.gmu.edu/~tsauer

Prerequisites: MATH 446

Text: *Numerical Analysis*, by T. Sauer, SECOND EDITION, Pearson 2012

Text Website: Useful Matlab files are available at http://wps.aw.com/aw_sauer_numerical_2/

The course will focus on advanced numerical methods, connecting ideas from the areas of computational mathematics, operations research and computer science, and using modeling and simulation to solve problems from physics, biology and engineering. From the methodological point of view, students will learn methods for the solution of algebraic equations, differential equations, audio and image processing, and optimization. Mathematical analysis from the textbook will be supplemented with articles from relevant application areas in science and engineering. Methods will be studied in the context of solving representative scientific and engineering problems from the following list.

- Differential equations

  - Euler Bernoulli beam
  - Tacoma Narrows bridge
  - Lorenz attractor and chaos
  - Orbital mechanics
  - Buckling of coronary stents
  - Heat flow on a cooling fin
- Optimization and least squares
  - Robotics
  - Global Positioning System
  - Protein-folding and conformation
  - Eigenvalues and Google
- Signal processing
  - Fourier analysis and interpolation
  - Noise reduction and filtering
  - Audio compression, AAC and MP3 etc.
  - Discrete cosine transform and JPEG standard
  - Compression of images

For each project, students are required to learn mathematical techniques relevant to the project solution, and to acquire basic competency in the application area of science or engineering through assigned readings. Secondary goals for the course are working proficiency in software packages, including Matlab.

Student participation will be done on the basis of group projects. Each group will consists of 2-3 students who will collaborate on all aspects of the problem solution. Typical projects will consist of four parts: (1) theoretical study and readings from the application area, identification of the underlying scientific and engineering principles of the problem; (2) mathematical formulation of a solution path using computational methods learned in class; (3) writing of software, following established principles from computer science, in Matlab or another convenient language, and its application to computationally solve the problem; (4) description of results, using text and graphics in a creative way. The description should be easily understandable by peers in the class.

Emphasis will be placed on clear communication of results through text and graphics. Finished write-ups for the projects will be submitted by the student working groups in HTML documents as part of oral class presentations at the completion of each project.

Honor Code: The University Honor Code is to be followed. Any violations will be submitted to the University Honor Committee.