Numerical Analysis Using MATLAB (001.2.7011)

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The course is designed to provide foundations for numerical methods/algorithms by using MATLAB as a computational platform. The course will cover both matrix manipulation philosophy, which is the advantage of MATLAB, syntax overview, and numerical examples to calculus and differential equations.

Prerequisite: Calculus, Linear Algebra and Differential Equations.

Lectures/Exercises/Credit: one-semester course, 3 weekly lecture hours, 3 credit points.

Grading: 40% midterm project + 60% final project.

Syllabus by topics:

- Basics and Syntax:
  - Matrix manipulation.
  - Input and output options.
  - Using functions for efficiency.
  - Symbolic calculus.
  - Types of errors.
- Data processing:
  - Solving for roots - linear and nonlinear equations using various methods.
  - Interpolation, curve fit and spline.
  - Fast Fourier transform (FFT).
  - Statistics.
  - Differentiation and integration schemes.
- Ordinary differential equations (ODEs):
  - Time integration of nonlinear equations (by different methods).
  - Fixed points and stability – eigenvalue problem.
  - Difference equations – iteration maps and transition to chaos.
  - Boundary value problems (BVP).
  - Continuation.
- Partial differential equations (PDEs):
  - Classification of PDEs and boundary conditions.
  - Finite differences: 1D explicit and implicit integrations, Crank–Nicolson method.
  - Alternative direction integration (ADI) method for 2D problems.

Bibliography:

- Numerical Methods For Engineers, Chapra and Canale, McGraw-Hill, 2010
  (most of the topics from this book are covered)
- Applied Numerical Methods Using MATLAB, Yang et al, Wiley, 2005
- Numerical Recipes, Press et al., Cambridge University Press, 1992