Faculty of Eng. & Natural Sci.

ENS409-202001

Numerical Analysis

Instructor

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Course Content

This course covers the use of numerical computing techniques for mathematical and scientific problems. Topics include: floating-point representation, approximations and computer arithmetic, error analysis, conditioning and stability, Taylor series, roots of nonlinear equations, Newton's method, curve fitting and interpolation, solution to systems of linear equations using techniques such as LU decomposition, Gaussian elimination, Jacobi, Gauss-Seidel iteration, eigenvalue problems, numerical integration and solutions to differential equations.

Recommend or Required Reading

Textbook

- Numerical Analysis, J. Douglas Faires and Richard L. Burden, Thomson Press, 2004 (9th edition is available as pdf)

Optional Readings

- Numerical Methods for Engineers, S. C. Chapra and R. P. Canale, 6th Edition, McGraw-Hill, 2010
- Applied Numerical Methods with MATLAB for Engineers and Scientists, S. C. Chapra, 3rd Edition., McGraw-Hill, 2012
- Numerical Methods Using MATLAB, J.H. Mathews & K.D. Fink, 4th Edition., Pearson, 2004

Course Outline

Analytical and exact methods can provide solutions for a limited class of problems. Practical real life problems often require computational solutions of complicated mathematical problems for arbitrarily shaped geometries and complicated material properties. Computers and numerical methods provide an alternative for such complicated problems. This course will give an introduction to numerical analysis for modeling various scientific problems. The advantages and drawbacks of various computational techniques will be provided. Students will gain hands-on experience for numerical solutions by developing simple computer codes.

Topics

- Introduction to Numerical Methods
- Mathematical Preliminaries and Error Analysis
- Solution of Nonlinear Equations
- Interpolation
- Least Squares Regression
- Matrices and Systems of Linear Equations
- Numerical Differentiation and Integration
- Ordinary Differential Equations
- Partial Differential Equations

Grading Policy

The course work for this class has three main components: 1. Homework, 2. Computer projects, and 3. Midterm/Final exam. Computer projects will allow students to gain hands-on experience about the course material. The computer projects will be carried out using MATLAB.

- Homework (15%)
- Projects (50%)
- Midterm/Final Exam (35%)

Course Policies

- Midterm/Final Exam will be given as Take-Home Exam.
- Make-up Exam will be given only for official excuses.
- Cheating is absolutely subject to a disciplinary action and a null grade.