Prerequisites

C or better in MATH 228 (Calculus III), MATH 325 (Linear Algebra); CSC 210 or MATH 309.

Bulletin Description


Course Objectives

Numerical analysis is about the study of algorithms for mathematical calculations using computers. It contains algorithms for solving equations, interpolation and approximations, algorithms for numerical integrations and differentiations, and error estimate and analysis as well as convergence studies, etc.

Students learn to implement numerical calculations effectively, understand the pros and cons of different implementation methodologies, and know how to approach a problem numerically.

Students who successfully complete the course should understand main sources of numerical errors, and understand the power of numerical methods that minimize these errors. Many applications can be used to illustrate these ideas; at the end of the course students will have achieved at least four of the following objectives:

- be able to find numerical solutions of linear and nonlinear equations effectively and understand the convergence properties of different algorithms and the conditioning of linear systems;
- understand the concept and algorithms of data interpolation including polynomial and spline interpolation;
- perform numerical integration and error analysis including Gaussian quadrature;
• find numerical solutions to differential equations;
• perform numerical differentiation and error analysis;
• find solutions of equations directly and/or iteratively;
• find the least square data or function approximations using families of linear and non-linear functions;
• generate orthogonal polynomials including the trigonometric polynomials and Chebyshev polynomials, and use orthogonal polynomials for data/function approximations;
• calculate Fourier series and Fourier transforms.

Evaluation of Students

Students will be graded on their ability to understand and use various numerical algorithms for the expected numerical accuracy and efficiency. Instructors may have their own methods of evaluating students’ performance, but generally these methods should include graded homework and projects, (at least one) mid-term examination and a final.

Sample Course Outline

<table>
<thead>
<tr>
<th>Topics</th>
<th>Number of Weeks</th>
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<tr>
<td>Mathematical preliminaries and error analysis</td>
<td>1</td>
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<tr>
<td>Solutions of equations of one variable</td>
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<tr>
<td>Interpolation and polynomial approximation</td>
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<tr>
<td>Numerical Integration and differentiation, solving differential equations</td>
<td>3</td>
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<tr>
<td>Methods for solving linear systems</td>
<td>3</td>
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<tr>
<td>Approximation Theory</td>
<td>3</td>
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Textbooks and Software

*Software package*: Matlab, Mathematica, C, depending on instructor’s selection.

Submitted by: Shidong Li     Date: June 10, 2003