数值分析 Numerical Analysis

- 教师介绍 Faculty

Ji Li （李季）

PhD
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Research Field: Number theory

Education

August, 1998 – May, 2004:
Boston University, Boston, Massachusetts, USA
PhD in Mathematics

September, 1994 – June, 1997:
Institute of Mathematics, Chinese Academy of Sciences, Beijing, China
MS in Mathematics

September, 1989 – June, 1994:
University of Science and Technology of China , Hefei, China
BS in Mathematics

Work Experience

July, 2007 - present: Lecturer
College of Science, Beijing University of Chemical Technology

Representative Publications: None

- **课程介绍 About Course**

This course is an introduction to the numerical methods for various problems in sciences and engineering. And it is designed for the foreign MS students in any science-based majors. The topics cover most of the basic numerical methods. With the given algorithms and the help of MatLab, the students will be able to solve simple problems in engineering.

Outlines:

1. Introduction to MATLAB (6 hours)
2. Systems of Linear Algebraic Equations (5 hours)
3. Interpolation and Curve Fitting (4 hours)
4. Roots of Equations (6 hours)
5. Numerical Differentiation (3 hours)
6. Numerical Integration (5 hours)
7. Initial Value Problems (4 hours)
8. Two-Point Boundary Value Problems (4 hours)
9. Symmetric Matrix Eigenvalue Problems (5 hours)
10. Introduction to Optimization (6 hours)

- **课程大纲 Syllabus**

Instructor: Ji Li, Dr.

Course Code: Math504e

Hours: 48

Credits: 3.0

Prerequisites: Some calculus and matrix theory

Description: This course is an introduction to the numerical methods for various problems in sciences and engineering. And it is designed for the foreign MS students in any science-based majors. The topics cover most of the basic numerical methods. With the given algorithms and the help of MATLAB, the students will be able to solve simple problems in engineering.

Textbook: J.Kiusalaas, 《Numerical Methods in Engineering with MATLAB》, Cambridge University Press, 2005.

References: J.Sizemore and J. P. Mueller, 《MATLAB for Dummies》, John Wiley & Sons, Inc. 2015

General Syllabus:

1. Introduction to MATLAB (6 hours)
   (1) Basic MATLAB: Mathematics calculation, variables, inputs and output; array and matrix operations; plotting.
   (2) Programming: Scripts, functions; flow control, loops.
2. Systems of Linear Algebraic Equations (5 hours)
   (1) Gaussian elimination, LU decomposition, pivoting;
   (2) Special matrices: Choleski decomposition, tri-diagonal, symmetric penta-diagonal.
   (3) Iterative methods (optional): Gauss-Seidel, conjugate gradient.

3. Interpolation and Curve Fitting (4 hours)
   (1) Interpolation: Lagrange, Newton, Neville; cubic spline,
   (2) Curve fitting: Least square fit, line regression, linear forms, polynomial fit.
4. Roots of Equations (6 hours)
   (1) Root of equation: Incremental search, bisection, Brent, Newton-Raphson;
   (2) System of equations: Newton-Raphson;
   (3) Zero of polynomial (optional): Evaluation, deflation, Laguerre method.
5. Numerical Differentiation (3 hours)
   (1) Finite difference approximation: Central, non-central, error, Richardson extrapolation;
   (2) Derivative by interpolation: Cubic spline.
6. Numerical Integration (5 hours)
   (1) Newton-Cotes: Midpoint, trapezoid, Simpson; composite, recursive trapezoid, Romberg.
   (2) Gaussian quadrature.
7. Initial Value Problems (4 hours)
   (1) Basic: Taylor series, Euler, Runge-Kutta;
   (2) Advanced: Adaptive Runge-Kutta, Midpoint, Bulirsch-Stoer.
8. Two-Point Boundary Value Problems (4 hours)
   (1) Shooting method: 2^{nd} order, higher order;
   (2) Finite difference method: 2^{nd} order, 4^{th} order.
9. Symmetric Matrix Eigenvalue Problems (5 hours)
   (1) Basic: Jacobi, power, inverse power;
   (2) Separation of eigenvalues: Householder reduction, separation eigenvalues,eigenvector.
10. Introduction to Optimization (6 hours)
    Golden search, conjugate gradient, powell, Fletcher-Reeves,

Grading: Project 20%; Homework 30%; Final exam 50%.

- 教案 **Teaching Plan**
- 视频 **Video**