**《数值计算方法》 全英课程教学大纲**

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| 课程名称 | Methods of Numerical Computation  |
| 适用专业 | Information and Computational Science |
| 先修课程 | Mathematical Analysis、Advanced Algebra、Programming Language |
| 推荐教材 | *John H. Mathews, Kurtis D. Fink,* Numerical Methods Using MATLAB(4th Edition).黄仿伦改编，电子工业出版社，2009.8.ISBN：978-7-121-09412-5 |
| 学习资源 | 1. Matlab正版安装软件：http://matlab.scnu.edu.cn/2. Matlab网站：https://www.mathworks.com/ |
| 一、课程简介The purpose of this course is to enable students to know well the construction principles and usages of common numerical methods for algebra, calculus, and differential equations, moreover to make some simple theoretical analysis of the properties of the problems, the errors and stability of the algorithms, etc. Meanwhile students are required to master some Matlab programming skills so that they can program some common numerical algorithms using Matlab which can be applied to solve some simple practical problems. |
| 二、理论教学内容及学时安排  |
| 章目编号 | 章目名称  | 教学内容与教学目标 | 学时安排  |
| 1 | Solution of Nonlinear Equation f(x)=01.1 Iteration for Solving x=g(x)1.2 Bracketing Methods for Locating a Root1.3 Newton-Raphson and Secant Methods | The goal of this chapter is to develop a variety of methods for finding numerical approximation for the roots of an equation, such as the bisection method, the fixed-point method and Newton-Raphson Method. | 10 |
| 2 | Solution of Linear Systems AX=B2.1 Upper-Triangular Linear Systems2.2 Gaussian Elimination and Pivoting2.3 Triangular Factorization2.4 Iterative Methods for Linear Systems | The goal of this chapter is to proceed two groups of methods for the solution of linear systems, including the so-called direct methods or elimination methods and iterative methods. | 12 |
| 3 | Interpolation and Polynomial Approximation3.1 Taylor Series and Calculation of Functions3.2 Introduction to Interpolation3.3 Lagrange Approximation3.4 Newton Polynomials3.5 Chebyshev Polynomials(Optional)3.6 Pade Approximations | It is the purpose of this chapter to introduce the classical theory of polynomial interpolation, including discussions on the effective numerical computation of interpolation polynomials and an analysis of the resulting approximation error.  | 14 |
| 4 | Curve Fitting4.1 Least-Squares Line4.2 Methods of Curve Fitting4.3 Interpolation by Spline Functions4.4 Bezier Curves | In the first two sections we proceed with a study of least-squares curve fitting. In the last sections we introduce the interpolation by splines, i.e., piecewise polynomial interpolation, and Bezier curves which has turned into a successful tool in computer-aided geometric design. | 12 |
| 5 | Numerical Integration5.1 Introduction to Quadrature5.2 Composite Trapezoidal and Simpson’s Rule5.3 Recursive Rules and Romberg Integration5.4 Gauss-Legendre Integration(Optional) | The purpose of this chapter is to develop the basic principles of numerical integration. The goal is to approximation the definite integral of f(x) over the interval [a,b] by evaluating f(x) at a finite number of sample points. The numerical integration formulas are used to derive the predictor-corrector methods for solving differential equations in the next chapter. | 12 |
| 6 | Solution of Differential Equations6.1 Introduction to Differential Equations6.2 Euler’s Method6.3 Heun’s Method | There is no known analytic solution for differential equations therefore numerical approximations are proposed in this chapter, including classic Euler’s method and Heun’s method. | 12 |
| 三、实验或实践环节安排 |
| 项目编号 | 项目名称 | 主要内容 | 开设要求 | 学时安排 |
| 1 | Solution of Nonlinear Equation | Compare the speed of global convergence algorithms and local convergence ones, and consider how to choose a good initial value to speed up the iterative process. | 1 | 4 |
| 2 | Solution of Linear Systems | Observe the results of Gaussian elimination and iterative methods for the ill-conditioned linear equations and consider how to improve the calculation accuracy. | 2 | 4 |
| 3 | Polynomial Interpolation | Observe the insufficiency of high-order polynomial interpolation even for analytic function, and consider how to improve the interpolation result. | 2 | 4 |
| 4 | Curve Fitting | Construct cubic spline interpolation functions with different boundary conditions. | 2 | 4 |
| 5 | Numerical Integration | Use Romberg integration to approximate some integrals and construct an adaptive integration algorithm. | 2 | 4 |
| 6 | Solution of Differential Equations | Solve the differential equations by Euler method and Heun’s method. | 1 | 4 |
| 四、教学方法Combination of the classroom teaching、the online teaching and the experiment teaching. |
| 五、考核方式A final test and experiments. |
| 六、成绩评定方式Test 70%; Experiments 20%; Homework 10%. |