课程详述

COURSE SPECIFICATION

　　以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

　　The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	数值分析　　Numerical Analysis
2.	授课院系 **Originating Department**	数学系　　Department of Mathematics
3.	课程编号 **Course Code**	MA305
4.	课程学分 Credit Value	3
5.	课程类别 **Course Type**	专业选修课　Major Elective Courses
6.	授课学期 **Semester**	秋季　Fall
7.	授课语言 **Teaching Language**	中英双语　English & Chinese
8.	授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） **Instructor(s), Affiliation& Contact** （**For team teaching, please list all instructors**）	杨将，数学系，副教授 慧园 3 栋 423 yangj7@sustc.edu.cn Yang Jiang, Mathematics, Associate Professor Room 423, Block 3, Wisdom Valley yangj7@sustc.edu.cn
9.	实验员/助教、所属学系、联系方式 **Tutor/TA(s), Contact**	无 NA
10.	选课人数限额(可不填) **Maximum Enrolment** （**Optional**）	

11.	授课方式 **Delivery Method**	讲授 **Lectures**	习题/辅导/讨论 **Tutorials**	实验/实习 **Lab/Practical**	其它(请具体注明) **Other（Please specify）**	总学时 **Total**
	学时数 **Credit Hours**	48			复习、考试（2周） Revision & Exam (2 weeks)	48

12.	先修课程、其它学习要求 **Pre-requisites or Other** **Academic Requirements**	数学分析 III（MA203a）（或数学分析精讲（MA213）） Mathematical Analysis III (MA203a) (or Real Analysis (MA213))
13.	后续课程、其它学习规划 **Courses for which this course** **is a pre-requisite**	后续课程为计算金融、计算物理、常微分方程数值解、偏微分方程数值解等。 Linear Algebra is a prerequisite for Computational Finance, Computational Physics, Numerical Methods for Ordinary Differential Equations, Numerical Methods for Ordinary Differential Equations, and etc.
14.	其它要求修读本课程的学系 **Cross-listing Dept.**	无 None

教学大纲及教学日历 SYLLABUS

15.　**教学目标 Course Objectives**

讲述数值分析的基本概念和理论，包括插值、数值逼近和曲线拟合、求解线性方程组的直接法和间接法、数值积分和矩阵特征值的求解方法。

To introduce the basic concepts in Numerical Analysis including interpolations, approximation theory, direct and indirect methods for solving systems of linear equations, numerical integrations and numerical methods for computing the eigenvalues.

16.　**预达学习成果 Learning Outcomes**

通过对本课程的学习，学生可以理解和掌握数值分析的基本理论和技巧,能够熟练掌握函数插值的基本理论和求解方法；熟练掌握函数逼近和曲线拟合的基本理论和算法；熟练掌握求解线性方程组的直接法和间接法；熟练掌握数值积分的相关理论和计算；理解求解矩阵特征值的幂法、反幂法和 QR 算法。通过本课程的学习，学生还能了解如何使用 MATLAB 等科学计算软件进行基本的数值计算。

After completing this course, students should understand a few basic methods and techniques in Numerical Analysis. They should be able to manipulate the theory and algorithm of interpolations for functions, manipulate the approximation theory and curve fitting methods, solve systems of linear equations with direct and indirect methods, manipulate the numerical integration algorithms, compute eigenvalues with the power method, the inverse power method and the QR method. After learning this course, students should be able to do the basic numerical computation using some mathematical softwares, such as Matlab, Maple.

17.　**课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）**
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

第一章 误差分析与科学计算引论（3学时）：截断误差、误差定性分析以及如何避免误差
Chapter 1. Mathematical Preliminaries and Error Analysis: Round-off Errors and Computer Arithmetic

第二章 函数零点的求解（3学时）：二分法，不动点法，牛顿迭代，迭代法的误差分析
Chapter 2. Solutions of Equations in One Variable: The Bisection Method, Fixed-Point Iteration, Newton's Method and Its Extensions, Error Analysis for Iterative Methods.

第三章 插值法（6学时）：拉格朗日插值，牛顿插值，Hermite 插值，三次样条插值
Chapter 3. Interpolation and Polynomial Approximation: Interpolation and the Lagrange Polynomial, Divided Differences, Hermite Interpolation, Cubic Spline Interpolation.

第四章 数值微分与数值积分（6学时）：数值微分，数值积分，复合数值积分，高斯求积公式
Chapter 4. Numerical Differentiation and Integration: Numerical Differentiation, Elements of Numerical Integration, Composite Numerical Integration, Gaussian Quadrature.

第五章 常微分方程数初值问题（6学时）：初值问题的基本定理，欧拉法，龙格库塔法，高阶方程，稳定性
Chapter 5 Initial-value Problems for Ordinary Differential Equations: The Elementary Theory of Initial-Value Problems, Euler's Method, Runge-Kutta Methods, Higher-Order Equations and Systems of Differential Equations, Stability.

第六章 解线性方程组的直接方法（6学时）：线性代数和矩阵求逆，矩阵行列式，矩阵分解，特殊矩阵
Chapter 6 Direct Methods for Solving Linear Systems: Pivoting Strategies, Linear Algebra and Matrix Inversion, The Determinant of a Matrix, Matrix Factorization, Special Types of Matrices.

第七章 解线性方程组的迭代法（6学时）：向量和矩阵范数，特征值和特征多项式，雅可比迭代、高斯-塞德尔迭代和超松弛迭代的算法和收敛性理论
Chapter 7 Iterative Techniques in Matrix Algebra: Norms of Vectors and Matrices, Eigenvalues and Eigenvectors, The Jacobi and Gauss-Siedel Iterative Techniques.

第八章 逼近论（3学时）：最小二乘法，正交多项式逼近
Chapter 8 Approximation Theory: Discrete Least Squares Approximation, Orthogonal Polynomials and Least Squares Approximation.

第九章 矩阵特征值计算（6学时）：幂法，反幂法，Householder 方法，QR 分解
Chapter 9 Approximating Eigenvalues: Orthogonal Matrices and Similarity Transformations, The Power Method, Inverse iteration and Rayleigh Quotient Iteration, Householder's Method, The QR Algorithm

第十章 非线性系统的求解（3学时）：不动点法，牛顿迭代
Chapter 10 Numerical Solutions of Nonlinear System of Equations: Fixed Points for Functions of Several Variable, Newton's Method.

18. 教材及其它参考资料 Textbook and Supplementary Readings

教材（Textbook）：Numerical Analysis, 9th Edition, by Richard L. Burden, J. Douglas Faires, Brooks/Cole, 2011.

推荐参考书（Supplementary Readings）：

1. 数值分析，颜庆津编著，北京航空航天大学出版社，2012年。
2. 数值分析，张平文，李铁军编著，北京大学出版社，2007。
3. 数值线性代数，徐树方，高立，张平文编著，北京大学出版社，2010。
4. 数值分析，李庆扬，王能超，易大义编著，清华大学出版社，2008。

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes

出勤 Attendance			
课堂表现 Class Performance			
小测验 Quiz	20%		
课程项目 Projects			
平时作业 Assignments	25%		
期中考试 Mid-Term Test	20%		
期末考试 Final Exam	35%		
期末报告 Final Presentation			
其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary)			

20.   记分方式 GRADING SYSTEM

☑ A. 十三级等级制 Letter Grading
☐ B. 二级记分制（通过/不通过） Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21.   本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority