

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	现代计算方法 Mordern Numerical Methods				
2.	授课院系 Originating Department	力学与航空航天工程系 Department of Mechanics and Aerospace Engineering				
3.	课程编号 Course Code	MAE323				
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	春季 Spring				
7.	授课语言 Teaching Language	英文 English				
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)	吴雷, 力学与航空航天工程系 (wul@sustech.edu.cn) Lei Wu, Department of Mechanics and Aerospace Engineering (wul@sustech.edu.cn)				
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	To be announced				
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	32		32		64
12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	Calculus II B (MA102C) ; Linear Algebra A (MA107A)				
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	NA				
14.	其它要求修读本课程的学系 Cross-listing Dept.	NA				

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

This course provides a fundamental introduction to numerical analysis suitable for undergraduate students in mathematics, computer science, physical sciences, and engineering. It is assumed that the reader is familiar with calculus and has taken a structured programming course. It covers numerous topics including Interpolation and Polynomial Approximation, Curve Fitting, Numerical Differentiation, Numerical Integration (of both ordinary and partial differential equations). Interesting examples including the simulations of Chaos (e.g. butterfly effect) and Solitons (solutions of nonlinear partial differential equations) will be covered. It is hoped that after the course students will be able to analyse the mathematical problems and write the computer codes to solve the practical engineering problems of interest.

16. 预达学习成果 Learning Outcomes

On completion of this course, students will be able to:

1. Find the roots of non-linear equations
2. Perform interpolation and polynomial approximation
3. Fit curves from the given (experimental) data
4. Do numerical differentiation and numerical integration
5. Solve the ordinary differential equations numerically
6. Solve the partial differential equations numerically

完成本课程后，学生将能够：

1. 求解非线性方程的根；
2. 能够进行插值和多项式逼近；
3. 根据给定（实验）数据拟合曲线；
4. 进行数值微分和数值积分；
5. 数值求解常微分方程组；
6. 数值求解偏微分方程组。

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.)



Section 1: Preliminary knowledge (4 credit hours)

- Review of Calculus
- Error Analysis
- Matlab preliminaries

Section 2: Non-linear equations (4 credit hours)

- Iteration method
- Bisection methods
- Newton-Raphson and Secant methods

Section 3: Numerical solution of linear equations (4 credit hours)

- Properties of Vectors and Matrices
- Triangular Factorization
- Iterative for linear systems
- Seidel and Newton's methods

Section 4: Interpolation and polynomial approximation (4 credit hours)

- Taylor series
- Lagrange approximation

Section 5: Interpolation and polynomial approximation (4 credit hours)

- Newton polynomials
- Chebyshev polynomials
- Pade Approximations

Section 6: Curve fitting (4 credit hours)

- Least-square line
- Spline Functions

Section 7: Fourier series and trigonometric polynomials (4 credit hours)

Section 8: Numerical differentiation (4 credit hours)

- Approximating the derivative
- Numerical differential formulas

Section 9: (4 credit hours)

- Fast Fourier Transform

Section 10: Numerical integration (4 credit hours)

- Introduction to quadrature
- Composite Trapezoidal and Simpson's rule
- Adaptive quadrature

Section 11: (4 credit hours)

- Gauss-Legendre quadrature
- Fast Fourier Transform

Section 12: Numerical solution of ordinary differential equation (4 credit hours)

- Euler's method
- Taylor-Series Method
- Runge-Kutta method



Section 13: (4 credit hours)

- Predictor-corrector method
- Systems of differential equation

Section 14: (4 credit hours)

- Boundary value problems
- Finite-difference
- Simulation of Chaos: butterfly effect etc.

Section 15: Numerical solution of partial differential equation (4 credit hours)

- Hyperbolic equations
- Parabolic equations

Section 16: (4 credit hours)

- Elliptic equations
- Fast Fourier Transform
- Nonlinear equations having soliton solutions

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

J. Mathews and Kurtis Fink, "Numerical Methods Using MATLAB"

Southern University
of Science and
Technology

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		10		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		40		
期中考试 Mid-Term Test		20		
期末考试 Final Exam		30		
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

力学与航空航天工程系教学指导委员会
 The commission of teaching instruction in department of mechanics and aerospace engineering