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	工程数学与数值计算 **Engineering Mathematics and Numerical Computation**
2.	授课院系 **Originating Department**	海洋科学与工程系 Department of Ocean Science and Engineering
3.	课程编号 **Course Code**	OCE214
4.	课程学分 Credit Value	4
5.	课程类别 **Course Type**	专业基础课 Major Foundational 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**）	林观，海洋科学与工程系，工学院南楼 208，ling@sustech.edu.cn Dr. Guan LIN, Department of Ocean Sciences and Engineering, College of Engineering 208, ling@sustech.edu.cn
9.	实验员/助教、所属学系、联系方式 **Tutor/TA(s), Contact**	待公布 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**	64				64

12.	先修课程、其它学习要求 **Pre-requisites or Other Academic Requirements**	高等数学 I（MA117）
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	
14.	其它要求修读本课程的学系 **Cross-listing Dept.**	

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程属于海洋工程与技术专业学生的专业核心课。经过本课程的学习，学生将：（1）系统地掌握工程数学方面的基本知识，包括方程与函数、复数、向量与矩阵、微积分、傅立叶与拉普拉斯变换、统计与曲线拟合、偏微分方程等，并能将上述知识应用到解决实际工程问题中；（2）掌握常见数值计算方法，包括方程数值求解、插值、拟合、数值微分、数值积分、微分方程的数值求解等，并了解上述数值计算方法在MATLAB软件中的实现。学生通过课堂学习与作业练习，掌握工程数学与数值计算方面的知识，培养思考能力和自主学习能力，对学生今后继续从事相关研究及工作具有重要的基础作用。

This course is a major core course of the major Ocean Engineering and Technology. After studying this course, students will: (1) systematically master the basic knowledge of engineering mathematics, including equations and functions, complex numbers, vectors and matrices, calculus, Fourier and Laplace transforms, statistics and curve fitting, partial differential equations, etc., and be able to apply the above knowledge to solve practical engineering problems; (2) master common numerical computational methods, including numerical solution of equations, interpolation, fitting, numerical differentiation, numerical integration, numerical solution of differential equations, etc., and understand the implementation of the above numerical calculation methods in MATLAB. Through classroom study and homework exercises, students will master the knowledge of engineering mathematics and numerical computation, cultivate their thinking ability and independent learning ability, which plays an important role in continuing to engage in related research and work in the future.

16. 预达学习成果 Learning Outcomes

通过本课程的学习，学生将能够：
1. 了解和学习工程数学方面的基本知识；
2. 运用工程数学中涵盖的基本原理和方法解决工程实际问题；
3. 掌握常见数值计算方法的数学理论、算法设计和误差分析等理论；
4. 能够利用 MATLAB 软件实现常见数值计算方法；
5. 提升思考和自学能力、解题实际问题的能力。

Upon completion of this course, students should be able to:
1. Understand and learn basic knowledge of engineering mathematics;
2. Use the basic principles and methods covered in engineering mathematics to solve practical engineering problems;
3. Master the mathematical theory, algorithm design and error analysis of common numerical computational methods;
4. Able to use MATLAB to implement common numerical computational methods;
5. Enhance the ability to think and learn independently, and the ability to solve practical problems

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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.)

本课程分为三部分 / this course includes the following three parts
    1. 工程数学 / Engineering Mathematics: 24 学时（包括 2 学时复习和 2 学时期中考试） / 24 hours (including 2 hours for review and 2 hours for mid-term test)
    2. 数值计算 / Numerical Computation 40 学时（包括 2 学时复习） / 40 hours (including 2 hours for review)
     总计/ Total: 64 学时 / 64 hours

Part 1 工程数学 （20 学时）

题目 1 数学基础（2 学时）
方程和函数、多项式和根、二项式定理和展开式、数列、指数和对数、三角学

题目 2 复数（2 学时）
复数、复代数、欧拉公式、双曲函数

题目 3 向量与矩阵（3 学时）
向量和向量代数、向量积、矩阵加法和乘法、变换和逆矩阵、线性方程组、特征值和特征向量

题目 4 微积分（4 学时）
微分、积分、常微分方程、偏微分、多重积分和特殊积分、复积分

题目 5 傅立叶和拉普拉斯变换（3 学时）
傅里叶级数和变换、使用傅里叶变换求解微分方程、拉普拉斯变换、通过拉普拉斯变换求解常微分方程

题目 6 统计与曲线拟合（3 学时）
概率与统计、高斯分布、最小二乘法、回归与曲线拟合、假设检验

题目 7 偏微分方程（3 学时）
一阶偏微分方程、二阶偏微分方程、经典数学模型、求解方法

Part 2 数值计算（38 学时）

题目 8 非线性方程求解（6 学时）
最小二乘法、牛顿-拉夫森迭代法、弦割法

题目 9 线性方程的数值解（4 学时）
上三角线性系统、高斯消去和主元、三角因式分解、线性系统迭代法

题目 10 插值和多项式逼近（4 学时）
拉格朗日多项式、牛顿多项式、切比雪夫多项式、样条函数插值、泰勒级数和帕德近似值

题目 11 曲线拟合（4 学时）
最小二乘法、曲线拟合方法、傅里叶级数和三角多项式、贝塞尔曲线

题目 12 数值微分（6 学时）
中心差分公式、误差分析和最佳步长、拉格朗日多项式和牛顿多项式微分

题目 13 数值积分（6 学时）
牛顿-科茨公式、梯形公式和辛普森公式、递归法和朗伯格积分、自适应正交

题目 14 常微分方程的数值解（4 学时）
欧拉法、海恩法、龙格-库塔法、微分方程组

题目 15 偏微分方程的数值解（4 学时）
双曲方程、抛物线方程、椭圆方程

Part 1 Engineering Mathematics

Topic 1 Fundamentals
Equations and functions, polynomials and roots, binomial theorem and expansions, sequences, exponentials and logarithms, trigonometry

Topic 2 Complex Numbers
Complex number, complex algebra, Euler's formula, hyperbolic functions

Topic 3 Vectors and Matrices
Vectors and vector algebra, vector products, matrix addition and multiplication, transformation and inverse, system of linear equations, eigenvalues and eigenvectors

Topic 4 Calculus
Differentiation, integration, ordinary differential equations, partial differentiation, multiple integrals and special integrals, complex integrals

Topic 5 Fourier and Laplace Transforms
Fourier series and transform, solving differential equations using Fourier transforms, Laplace transforms, solving ODE via Laplace transform

Topic 6 Statistics and Curve Fitting
Probability and statistics, gaussian distribution, method of least squares, regression and curve fitting, hypothesis testing

Topic 7 Partial Differential Equations First-Order PDEs, second-order PDEs, classic mathematical models, solution techniques

Part 2 Numerical computation

Topic 8 Solving Non-linear Equations (6 hours)

Bracketing method, Newton-Raphson method, secant method

Topic 9 Numerical Solution of Linear Equations (4 hours)
Upper-triangular linear systems, Gaussian elimination and pivoting, triangular factorization, iterative methods for linear systems

Topic 10 Interpolation and Polynomial Approximation (4 hours)
Lagrange polynomials, Newton polynomials, Chebyshev polynomials, interpolation by spline functions, Taylor series and Pade approximations

Topic 11 Curve Fitting (4 hours)
Least-squares line, methods of curve fitting, Fourier series and trigonometric polynomials, Bézier curves

Topic 12 Numerical Differentiation (6 hours)
Central-difference formulas, error analysis and optimum step size, differentiation of the Lagrange polynomial and Newton polynomial

Topic 13 Numerical Integration (6 hours)
Newton-Cotes Precision, trapezoidal and Simpson's rule, recursive rules and Romberg integration, adaptive quadrature

Topic 14 Numerical Solution of ODE (4 hours)
Euler's method, Heun's method, Runge-Kutta method, systems of differential equations

Topic 15 Numerical Solution of PDE (4 hours)
Hyperbolic equations, parabolic equations, elliptic equations

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

- Introductory Mathematics for Engineering Application, 2nd Edition, by Kuldip S. Rattan, Nathan W. Klingbeil, Craig M. Baudendistel
- Advanced Engineering Mathematics, 10th Edition, by E. Kreyszig
- Numerical Methods Using MATLAB, 4th Edition, by John. H. Mathews and Kurtis D. Fink
- Engineering Mathematics with Examples and Applications, by Xin-She Yang

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		5		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		20		
期中考试 Mid-Term Test		15		
期末考试		60		

Final Exam				
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**

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课程审批 **REVIEW AND APPROVAL**

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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

   教学负责人签字： 日期：