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	常微分方程 A (H)　　Ordinary Differential Equations A(H)
2.	授课院系 **Originating Department**	数学系　Mathematics
3.	课程编号 **Course Code**	MA230
4.	课程学分 Credit Value	4
5.	课程类别 **Course Type**	专业核心课 Major Core Courses
6.	授课学期 **Semester**	春季 Spring
7.	授课语言 **Teaching Language**	英文 English / 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**）	苏琳琳（sull@sustech.edu.cn），王学锋(wangxf@sustech.edu.cn)，王勇（wangy66@sustech.edu.cn），数学系 Linlin Su(sull@sustech.edu.cn)， Xuefeng Wang(wangxf@sustech.edu.cn)，Yong Wang（wangy66@sustech.edu.cn）， Department of Mathematics
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**	48	32	0	0	80

12.	先修课程、其它学习要求 **Pre-requisites or Other Academic Requirements**	MA203a 数学分析 III 或者 MA213-16 数学分析精讲，MA104b 线性代数 II Mathematical Analysis III (MA203a) or Real Analysis (MA213) and Linear Algebra II (MA104b)
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	MA303 偏微分方程 Partial Differential Equations (MA303)
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**

本课程在常微分方程 A 的基础上，增加了一些有深度且有益于将来科研的内容，如 Poincare-Bendixson 定理，极限环，Sturm-Liouville 理论等等。一方面，向同学们介绍更深层次的常微分方程基础知识，一方面，希望借此能够激发学生科研的兴趣。

On the basis of Ordinary Differential Equations A, this course adds some contents that are deep and beneficial for future scientific research, such as Poincare-Bendixson theorem, limit cycles, Sturm-Liouville theory, and so on. On the one hand, one would like to introduce the deeper basic knowledge of ordinary differential equations to students, and on the other hand, one hopes to stimulate students' interest in scientific research.

16. **预达学习成果 Learning Outcomes**

学生通过本课程的学习，将全面深入了解常微分方程的起源、发展以及前沿进展。学会用常微分方程对实际问题进行建模处理；理解并掌握一阶、二阶直至 n 阶单个线性常微分方程和一阶线性常微分方程组的各种解法；理解并掌握常微分方程的定性研究，如 Cauchy 问题解的存在唯一性及其稳定性，Sturm-Liouville 理论。

Through the study of this course, students will have a comprehensive and in-depth understanding of the origin, development and frontier progress of Ordinary Differential Equations. Learn how to use ordinary differential equations to model practical problems. Understand and master the solving methods of the first order, second order and n-order single linear ordinary differential equation and the first order linear system of ordinary differential equations. Understand and master the qualitative study of ordinary differential equations , such as the existence and uniqueness of solutions of Cauchy problems and their stability, Strum-Liouville theory.

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.)

1. 基本概念（2学时）
  1.1 基本模型；方向场
  1.2 微分方程通解的定义
  1.3 微分方程的分类

2. 一阶常微分方程（14学时）
  2.1. 线性方程；积分因子法
  2.2. 分离变量法
  2.3. 一阶常微分方程的建模
  2.4. 恰当方程和积分因子
  2.5. 初等变换法
  2.6. 皮卡存在唯一性定理
  2.7. 皮卡存在唯一性定理的证明
  2.8. 佩亚诺存在性定理
  2.9. 解的延拓
  2.10. 比较定理

3. 二阶线性常微分方程（8学时）
  3.1. 常系数齐次方程
  3.2. 求解线性齐次方程；朗斯基行列式
  3.3. 具有复根的特征方程
  3.4. 重根情形；降阶解法
  3.5. 非齐次方程；待定系数法
  3.6. 参数变易法
  3.7. 机械振动和电震荡

4. n 阶线性常微分方程（2学时）
  4.1. n 阶线性常微分方程的一般理论
  4.2. 常系数齐次方程情形
  4.3. 待定系数法
  4.4. 参数变易法

5. 一阶线性常微分方程组（8学时）
  5.1. 介绍
  5.2. 矩阵知识
  5.3. 一阶线性常微分方程组的基本理论
  5.4. 解对初值和参数的连续依赖性
  5.5. 常系数线性齐次方程组
  5.6. 复特征值情形
  5.7. 基解矩阵
  5.8. 重特征值情形
  5.9. 线性非齐次方程组

6. 非线性常微分方程系统及其稳定性（8学时）
  6.1. 相平面：线性系统
  6.2. 自治系统及其稳定性
  6.3. 局部线性系统
  6.4. 李雅普诺夫第二方法
  6.5 周期解和极限环
  6.6 庞加莱-本迪克松定理

7. 施图姆-刘维尔理论（6学时）
  7.1. 特征值和特征函数
  7.2. 特征值的存在性及其性质
  7.3. 应用于热方程

1. Introduction (2 Credit Hours)
  1.1. Some Basic Mathematical Models; Direction Fields
  1.2. Solutions of Some Differential Equations
  1.3. Classification of Differential Equations

2. First Order Differential Equations (14 Credit Hours)
    2.1. Linear Equations; Method of Integrating Factors
    2.2. Separable Equations in Variables
    2.3. Modeling with First Order Equations
    2.4. Exact Equations and Integrating Factors
    2.5. Elementary Transformation Method
    2.6. The Existence and Uniqueness Theorem
    2.7. Proof of the Existence and Uniqueness Theorem
    2.8. Peano's Existence Theorem
    2.9. Extensions of Solutions
    2.10. Comparison Theorems

3. Second Order Linear Equations (8 Credit Hours)
    3.1. Homogeneous Equations with Constant Coefficients
    3.2. Solutions of Linear Homogeneous Equations; the Wronskian
    3.3. Complex Roots of the Characteristic Equation
    3.4. Repeated Roots; Reduction of Order
    3.5. Nonhomogeneous Equations; Method of Undetermined Coefficients
    3.6. Variation of Parameters
    3.7. Mechanical and Electrical Vibrations

4. High Order Linear Equations (2 Credit Hours)
    4.1. General Theory of nth Order Linear Equations
    4.2. Homogeneous Equations with Constant Coefficients
    4.3. The Method of Undetermined Coefficients
    4.4. The Method of Variation of Parameters

5. Systems of First Order Linear Equations (8 Credit Hours)
    5.1. Introduction
    5.2. Review of Matrices
    5.3. Basic Theory of Systems of First Order Linear Equations
    5.4. Continuous Dependence of Solutions on Initial Conditions and Parameters
    5.5. Homogeneous Linear Systems with Constant Coefficients
    5.6. Complex Eigenvalues
    5.7. Fundamental Matrices
    5.8. Repeated Eigenvalues
    5.9. Nonhomogeneous Linear Systems

6. Nonlinear Differential Equations and Stability (8 Credit Hours)
    6.1. The Phase Plane: Linear Systems
    6.2. Autonomous Systems and Stability
    6.3. Locally Linear Systems
    6.4. Liapunov's Second Method
    6.5 Periodic Solutions and Limit Cycles
    6.6 Poincare-Bendixson Theorem

7. Sturm-Liouville theory (6 Credit Hours)
    7.1. Eigenvalues and eigenfunctions
    7.2. Existence and properties of eigenvalues
    7.3. An application to the heat equation

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

Textbook:
Elementary Differential Equations and Boundary Value Problems, 11th edition, William E. Boyce, Richard C. DiPrima and Douglas C. Meade, Wiley, 2017.

Reference:
常微分方程教程, 第二版, 丁同仁, 李承治, 高等教育出版社, 2004 年.

课程评估 ASSESSMENT

19.   评估形式   评估时间   占考试总成绩百分比   违纪处罚   备注

Type of Assessment	Time	% of final score	Penalty	Notes
出勤 Attendance				
课堂表现 Class Performance				
小测验 Quiz	10-30 minutes per week	20		
课程项目 Projects				
平时作业 Assignments	4 hours per week	20		
期中考试 Mid-Term Test	2 hours	25		
期末考试 Final Exam	3 hours	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