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**	控制工程数学基础 Mathematical Foundations of Control Engineering
2.	**授课院系 Originating Department**	系统设计与智能制造学院 School of System Design and Intelligent Manufacturing
3.	**课程编号 Course Code**	SDM234
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）**	徐翔 副教授 系统设计与智能制造学院 xux3@sustech.edu.cn XU Xiang Associate Professor School of System Design and Intelligent Manufacturing xux3@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	0	0		64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA127 高等数学（下），PHY106 大学物理（下），MA113 线性代数 MA127 Calculus II，PHY106 College Physics II，MA113 Linear Algebra
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	本课程为自动化专业基础课，是部分专业核心课的先修课程。 This course is a Major Foundation Course of Automation, to prepare for the mathematics expected in more advanced physical courses.
14. 其它要求修读本课程的学系 Cross-listing Dept.	电子与电气工程系、力学与航空航天工程系 Department of Electric and Electronic Engineering and Department of Mechanics and Aerospace Engineering

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程教授学生如何使用数学工具和技术来解决物理问题；使学生学到相关基础知识，并引导学生从纯数学的学习转到将数学应用于实际工程问题。

As the Major Foundation of Automation, this course aims to introduce how to use mathematics as a tool & technique to deal with engineering problems. From the course, students should transform from learning pure mathematics to using mathematics solve actual engineering problem.

16. 预达学习成果 Learning Outcomes

掌握复变函数、数学物理方程和特殊函数的基本概念和理论。能用留数定理计算积分、提高抽象思维能力和符号运算能力、以及能把物理问题写成数学方程和边界条件等。能够掌握求解一阶、二阶及高阶常微分方程的常用方法，初步了解偏微分方程的知识，应用分离变量法求解常见的二阶偏微分方程。

Master functions of a complex variable, ordinary and partial differentials closely related to physical problems and special functions. Master using the residue theorem to calculate definite integrals; improve abilities in abstract thinking and symbolic analysis. Master the common methods for solving first-order, second-order and high-order ODEs. Master the separation of variables method to solve second-order PDEs.

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.)

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1). 复函数和双曲函数（8学时）
第1周：复数运算、极坐标表示、de Moivre's 定理
第2周：复函数（对数、幂级数），复数简单的应用、微分和积分，双曲函数

2). 复变量函数的微积分（16学时）
第3周：复变函数、复变函数微分、Cauchy–Riemann 关系
第4周：复数项幂级数，多值函数，函数的奇点、零点
第5周：复变函数的环路积分，Cauchy 定理、 Cauchy 积分公式
第6周：Taylor级数和Laurent级数、留数定理、用留数定理计算定积分

3). 一阶常微分方程（12学时）
第7周：线性方程；积分因子法；分离变量法
第8周：一阶常微分方程的建模；恰当方程和积分因子
第9周：初等变换法；比较定理；期中考试

4). 二阶线性常微分方程（8学时）
第10周： 常系数齐次方程；求解线性齐次方程；朗斯基行列式；具有复根的特征方程；
第11周：重根情形; 降阶解法；非齐次方程；待定系数法；参数变易法；机械振动和电震荡

5). 高阶线性常微分方程（6学时）
第12周：高阶线性常微分方程的一般理论；常系数齐次方程情形；待定系数法；参数变易法
第13周上：拉普拉斯变换解常微分方程

6). 一阶线性常微分方程组（6学时）
第13周下：介绍；矩阵知识；常系数线性齐次方程组；复特征值情形
第14周：基解矩阵；重特征值情形；线性非齐次方程组

7). 偏微分方程初步（8学时）
第15周：重要的偏微分方程、通解、通解和特解
第16周：波动方程、扩散方程；分离变量法

1). Complex numbers and hyperbolic functions (8 Credit Hours)
Week 1: Manipulation of Complex Numbers, Polar Representation of Complex Numbers, De Moivre's Theorem
Week 2: Complex Logarithms and Complex Powers, Applications to Differentiation And Integration, Hyperbolic Functions

2). Complex Variables (16 Credit Hours)
Week 3: Functions of a Complex Variable, The Cauchy–Riemann Relations
Week4: Power Series in A Complex Variable, Multivalued Functions and Branch Cuts, Singularities and Zeros Of Complex Functions,
Week 5: Complex Integrals, Cauchy's Theorem, Cauchy's Integral Formula
Week 6: Taylor and Laurent Series, Residue Theorem, Definite Integrals Using Contour Integration

3). First Order Differential Equations (12 Credit Hours)
Week 7: Linear Equations; Method of Integrating Factors; Separable Equations in Variables
Week 8: Modeling with First Order Equations; Exact Equations and Integrating Factors
Week 9: Elementary Transformation Method; Comparison Theorems

4). Second Order Linear Equations (8 Credit Hours)
Week 10: Homogeneous Equations with Constant Coefficients; Solutions of Linear Homogeneous Equations; the Wronskian; Complex Roots of the Characteristic Equation
Week 11: Repeated Roots; Reduction of Order; Nonhomogeneous Equations; Method of Undetermined Coefficients; Variation of Parameters; Mechanical and Electrical Vibrations

5). High Order Linear Equations (6 Credit Hours)
Week 12: General Theory of High Order Linear Equations; Homogeneous Equations with Constant Coefficients; The Method of Undetermined Coefficients; The Method of Variation of Parameters
Week 13(I): Solving ODEs using Laplace Transforms

6). Systems of First Order Linear Equations (6 Credit Hours)
Week 13(II): Introduction; Review of Matrices; Homogeneous Linear Systems with Constant Coefficients; Complex Eigenvalues

Week 14: Fundamental Matrices; Repeated Eigenvalues; Nonhomogeneous Linear Systems

7). Introduction to Partial Differential Equations (8 Credit Hours)
Week 7: Important Partial Differential Equations, General Form of Solution, General and Particular Solutions;
Week 8: The Wave Equation, The Diffusion Equation, Separation of Variables

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

教材：调整
Advanced Engineering Mathematics, 10th edition, Erwin Kreyszig, Herbert Kreyszig and Edward J. Norminton.
其他参考资料：

- Mathematical Methods for Physics and Engineering; Third Edition; K.F. RILEY, M.P. HOBSON and S. J. BENCE; Cambridge university press
- Essential Mathematical Methods for Physicists; Hans J. Weber and George B. Arfken; Academic Press
- Elementary Differential Equations and Boundary Value Problems, 11th edition, William E. Boyce, Richard C. DiPrima and Douglas C. Meade, Wiley, 2017.
- 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.
- Mathematical Methods in the Physical Sciences, by Mary L. Boas. The third Edition; Wiley

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		10		
课程项目 Projects				
平时作业 Assignments		10		
期中考试 Mid-Term Test		30		
期末考试		50		

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**

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

自动化教学委员会