微分方程 教学大纲

Differential Equations Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100313003	开课学期: Semester	3
课程分类: Category	专业教育 PA	所属课群: Section	专业基础 MF
课程学分: Credit Points	3.5	总学时/周: Total Hours/Weeks	56/10
理论学时: LECT. Hours	56	实验学时: EXP. Hours	0
PBL 学时: PBL Hours	0	实践学时/周: PRAC. Hours/Weeks	0/0
开课学院: College	东北大学 悉尼智能科技学院 Sydney Smart Technology College Northeastern University	适用专业: Stream	应用统计学 AS
课程属性: Pattern	必修 Compulsory	课程模式: Mode	互认 EQV
中方课程协调人: NEU Coordinator	刘超 Liu Chao	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	数学分析与建模（一），数学分析与建模（二） Mathematical Analysis and Modelling (I), Mathematical Analysis and Modelling (II)		
英文参考教材: EN Textbooks	Vladimir I. Arnold, Ordinary Differential Equations, World Science Press, 2004.		
中文参考教材: CN Textbooks	王高雄，常微分方程， 高等教育出版社，2004.		
教学资源: Resources	https://sstc.cloudcampus.com.cn/course/view.php?id=18		
课程负责人(撰写人): SubjectDirector	刘超 Liu Chao	提交日期: Submitted Date	单击或点击此处输入日期。
任课教师(含负责人): Taught by	刘超 Liu Chao		
审核人: Checked by	韩鹏	批准人: Approvedby	史闻博
		批准日期: Approved Date	单击或点击此处输入日期。

二、教学目标 Subject Learning Objectives (SLOs)

注：毕业要求及指标点可参照悉尼学院本科生培养方案，可根据实际情况增减行数

Note: GA and index can be referred from undergraduate program in SSTC website. Please add/reduce lines based on subject.

整体目标: Overall Objective	微分方程是应用统计专业课程的基础，通过学习极限、微分、积分等重要概念，为学生学习其它学科以至于专业课程打下扎实基础。培养学生较强的动手能力，以及思维的逻辑性、严谨性、创新性，以及利用数学原理和方法解决实际问题的意识、兴趣和能力。 培养学生掌握微分方程的基本理论和方法，尤其是思维方式，掌握知识技能的同时发展创造能力。 Differential equation is the foundation of science and engineering courses. By learning the important concepts of limit, differential and integral, it can lay a solid foundation for students to learn other subjects and even professional courses. To cultivate students' strong practical ability, logical, rigorous and innovative thinking, as well as the consciousness, interest and ability of solving practical problems by using mathematical principles and methods. Cultivate students to master the basic theories and methods of differential equation, especially the way of thinking, master knowledge and skills, and develop creative ability at the same time.	
（1）专业目标: Professional Ability	1-1	具有扎实的专业基础与学科特长，系统掌握统计与数据分析、智能仿真建模技术、量化管理优化技术、试验设计与分析、项目管理与决策及其相关领域的专门知识与技能。 A solid professional foundation and competency, systematical mastery of the specialized knowledge and skills in statistics and data analysis, intelligent simulation modeling technology, quantitative management optimization technology, experimental design and analysis, project management and decision-making.
	1-2	具有卓越的技术素养和突出的应用统计学实践能力，具备在应用统计学及其相关领域通过科学技术理论和方法创造性的解决复杂问题、从事学术前沿问题研究的能力。 Excellent technical literacy, outstanding practical skills in applied statistics, and capable of creatively solving complex engineering problems in applied statistics and related fields through scientific and technological theories and engineering practical methods, as well as the ability of doing academic cutting-edge project research.
（2）德育目标: Essential Quality	2-1	理解高等数学理论知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the advanced mathematics in depicting the practical engineering problems.
	2-2	认知当前全球，数学理论的发展对提升中国工程关键技术及核心竞争力的重要意义。 Understand the technology development, key techniques and the core competitiveness in the area of the China engineering in the world.

	2-3	培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难而上的精神，并在学习过程中培养自己的细心和耐心的勇气和精神 Cultivate the spirit of not fearing difficulties or failure, perseverance, daring to try, and cultivate their own careful and patient courage and spirit in the process of learning
	2-4	培养服务意识，具有“以人为本” 的服务精神 Cultivate service consciousness and have the service spirit of "people-oriented"
	2-5	培养遵守法律、懂规则、守规则的新时代公民 Cultivate citizens of the new era who abide by the law, understand and obey the rules
	2-6	了解主要矛盾和次要矛盾，在面对复杂问题的时候要实事求是、抓住主要矛盾 Understand the main contradiction and secondary contradiction, seek truth from facts and grasp the main contradiction in the face of complex problems
	2-7	培养有条理和计划，做到心中有数、有条不紊、循序渐进地完成一项工作 Cultivate a sense of order and plan, and complete a work in an orderly and gradual manner

课程教学目标与毕业要求的对应关系 Matrix of GA & SLOs

毕业要求 GA	指标点 GA Index	教学目标 SLOs
1、理学知识：具有扎实的数学基础，能够将数学、自然科学和专业知识用于解决复杂实际问题。 Apply knowledge of mathematics, natural science, fundamentals and an engineering specialization to the solution of complex engineering problems.	指标点 1-1：具有较强的演绎推理能力、准确计算能力、分析归纳能力、抽象思维能力，掌握数学、自然科学和相关专业知识，并使用其建立正确的数学、物理学等模型以解释复杂实际问题。 Capable of deductive reasoning, accurate calculation, analysis and induction and abstract thinking. Establishing correct mathematical and physical models with the professional knowledge of mathematics, natural science, etc. to solve complex practical problems.	1-1, 1-2, 2-1 到 2-7
2、问题分析：能够借助应用统计学的基本原理、方法和手段，识别、表达、并通过文献研究分析复杂实际问题，以获得有效结论。 Identify, formulate, research literature and analyze complex practical problems reaching substantiated conclusions using first	2-1 能够应用数学、自然科学和工程学的基本原理、方法和手段，分析、识别、表达本专业相关的复杂工程问题。 Capable of analyzing, identifying and elaborating complex practical problems related to this major with the applying of the basic principles of Applied Statistics.	1-1, 1-2, 2-1 到 2-7
	2-2 能够应用数学、自然科学和工程学的基本原理、方法和手段，针对实际复杂工程问题设计针对性的技术方案，并综	

principles of mathematics and sciences.	合运用文献、科学基座和技术手段予以解决。 Capable of drawing on the basic principles of applied statistics to design targeted schemes for complex practical problems, and using literature, scientific theories and technical means to solve them.	

三、教学内容 Content (Topics)

注：以中英文填写，各部分内容的表格可根据实际知识单元数量进行复制、扩展或缩减

Note: Filled in both CN and EN, extend or reduce based on the actual numbers of knowledge unit

(1) 理论教学 Lecture

知识单元序号: Knowledge Unit No.	1	支撑教学目标: SLOs Supported	1-1，1-2
知识单元名称 Unit Title	一阶微分方程的初等解法 Fundamental solving method of the first order differential equation		
知识点: Knowledge Delivery	变量分离方程的概念与解法；贝努利方程解法； Definition and solving method of variable separable equation Solving method of Bernulli equation		
	线性微分方程与常数变易法； Linear differential equation and constant variation method		
	恰当微分方程与积分因子； Appropriate differential equation and integral coefficient		
	一阶隐式微分方程与参数表示。 The first order implicit differential equation and parametric representation		
学习目标: Learning Objectives	了解: Recognize	变量分离方程的概念与解法；贝努利方程解法； Definition and solving method of variable separable equation Solving method of Bernulli equation	
	理解: Understand	线性微分方程与常数变易法； Linear differential equation and constant variation method	
	掌握: Master	恰当微分方程与积分因子； Appropriate differential equation and integral coefficient	
德育目标 Moral Objectives	2-1 理解微分方程理论知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the differential equation in depicting the practical engineering problems.		
	2-3 认知当前全球，数学理论的发展对提升中国工程关键技术及核心竞争力的重要意义。 Understand the technology development, key techniques and the core competitiveness in the area of the China engineering in the world.		
	2-4 培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难而		

	上的精神，并在学习过程中培养自己的细心和耐心的勇气和精神 Cultivate the spirit of not fearing difficulties or failure, perseverance, daring to try, and cultivate their own careful and patient courage and spirit in the process of learning
重点: Key Points	恰当微分方程与积分因子； Appropriate differential equation and integral coefficient
难点: Focal points	一阶隐式微分方程与参数表示。 The first order implicit differential equation and parametric representation

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-1，1-2
知识单元名称 Unit Title	一阶微分方程的解的存在定理 Existence theorem of solution of the first order differential equation		
知识点: Knowledge Delivery	解的存在唯一性定理与逐步逼近法（存在唯一性定理，近似计算和误差估计） Existence of unique solution and approximation (Existence theorem of unique solution, approximate calculation, error estimation)		
	解对初值的连续性和可微性定理； Continuity of solution depending on initial value and differentiability theorem.		
学习目标: Learning Objectives	了解: Recognize	解的存在唯一性定理 Existence theorem of unique solution	
	理解: Understand	解的近似计算 Approximate calculation of solution	
	掌握: Master	解的误差估计） Error estimation of solution	
德育目标 Moral Objectives	2-1 理解微分方程理论知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the differential equation in depicting the practical engineering problems.		
	2-4 培养服务意识，具有“以人为本” 的服务精神 Cultivate service consciousness and have the service spirit of "people-oriented"		
	2-5 培养遵守法律、懂规则、守规则的新时代公民 Cultivate citizens of the new era who abide by the law, understand and obey the rules		
重点: Key Points	解对初值的连续性 Continuity of solution depending on initial value		
难点: Focal points	解可微性定理； Differentiability theorem of solution.		

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-1，1-2
知识单元名称 Unit Title	高阶微分方程 Higher order differential equation		

知识点: Knowledge Delivery	线性微分方程的一般理论； General theory of linear differential equation	
	齐线性方程的解的性质与结构； The property and structure of solution of homogeneous linear equation	
	非齐线性方程与常数变易法； Nonhomogeneous linear equation and constant variation method	
	常系数线性微分方程的解法； Solving method of ordinary linear differential equation with constant coefficient	
学习目标: Learning Objectives	了解: Recognize	线性微分方程的一般理论； General theory of linear differential equation
	理解: Understand	常系数齐线性方程和欧拉方程； Homogeneous equation with constant coefficient and Euler equation
	掌握: Master	常系数线性微分方程的解法； Solving method of ordinary linear differential equation with constant coefficient
德育目标 Moral Objectives	2-2 认知当前全球，数学理论的发展对提升中国工程关键技术及核心竞争力的重要意义。 Understand the technology development, key techniques and the core competitiveness in the area of the China engineering in the world.	
	2-5 培养遵守法律、懂规则、守规则的新时代公民 Cultivate citizens of the new era who abide by the law, understand and obey the rules	
	2-6 了解主要矛盾和次要矛盾，在面对复杂问题的时候要实事求是、抓住主要矛盾 Understand the main contradiction and secondary contradiction, seek truth from facts and grasp the main contradiction in the face of complex problems	
重点: Key Points	非齐线性方程的比较系数法与拉普拉斯变换法； Comparison coefficient method Laplacian variation method of nonhomogeneous linear equation	
难点: Focal points	高阶微分方程的降阶和幂级数解法； Order reduction and power series solving method of higher order differential equation	

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-1，1-2
知识单元名称 Unit Title	线性微分方程组 Linear differential equations		
知识点: Knowledge Delivery	线性微分方程组的一般理论； General theory of linear differential equations		
	齐线性微分方程组； Homogeneous linear differential equations		
	常系数线性微分方程组；		

	Linear differential equations with constant coefficient	
学习目标: Learning Objectives	了解: Recognize	线性微分方程组的一般理论; General theory of linear differential equations
	理解: Understand	非齐线性微分方程组; Nonhomogeneous linear differential equation
	掌握: Master	矩阵指数 expA 的定义和性质; Definition and properties of matrix exponent
德育目标 Moral Objectives	2-1 理解微分方程理论知识对于刻画工程实践问题的重要意义。 Understand the significant meanings of the differential equation in depicting the practical engineering problems.	
	2-6 了解主要矛盾和次要矛盾，在面对复杂问题的时候要实事求是、抓住主要矛盾 Understand the main contradiction and secondary contradiction, seek truth from facts and grasp the main contradiction in the face of complex problems	
	2-7 培养有条理和计划，做到心中有数、有条不紊、循序渐进地完成一项工作 Cultivate a sense of order and plan, and complete a work in an orderly and gradual manner	
重点: Key Points	非齐线性微分方程组; Nonhomogeneous linear differential equation	
难点: Focal points	基解矩阵的计算公式。 Calculus formula of fundamental matrix	

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-1，1-2
知识单元名称 Unit Title	非线性微分方程 Nonlinear differential equations		
知识点: Knowledge Delivery	解的稳定性概念; Definition of stability of solution		
	常微分方程组的存在唯一性定理; Existence of unique solution of ordinary differential equations		
	李雅普诺夫稳定性; Lyapunov stability		
	稳定、不稳定、渐近稳定的概念。 Definition of stability, instability, appropriate stability		
学习目标: Learning Objectives	了解: Recognize	解的稳定性概念; Definition of stability of solution	
	理解: Understand	稳定、不稳定、渐近稳定的概念。 Definition of stability, instability, appropriate stability	
	掌握: Master	李雅普诺夫稳定性; Lyapunov stability	
德育目标 Moral Objectives	2-2 认知当前全球，数学理论的发展对提升中国工程关键技术及核心竞争力的重要意义。 Understand the technology development, key techniques and the core		

	competitiveness in the area of the China engineering in the world.
	2-4 培养服务意识，具有“以人为本”的服务精神 Cultivate service consciousness and have the service spirit of "people-oriented"
	2-5 培养遵守法律、懂规则、守规则的新时代公民 Cultivate citizens of the new era who abide by the law, understand and obey the rules
重点: Key Points	常微分方程组的存在唯一性定理； Existence of unique solution of ordinary differential equations
难点: Focal points	李雅普诺夫稳定性； Lyapunov stability

四、教学安排 Teaching Schedule

注：可根据实际情况增减行数

Note: Please add/reduce lines based on subject.

教学内容 Teaching Content	学时(周)Hour(Week)			
	理论 LECT.	实验 EXP.	实践 PRAC.	PBL
一阶微分方程的初等解法 Fundamental solving method of the first order differential equation	18	0	0	0
一阶微分方程的解的存在定理 Existence theorem of solution of the first order differential equation	6	0	0	0
高阶微分方程 Higher order differential equation	12	0	0	0
线性微分方程组 Linear differential equations	14	0	0	0
非线性微分方程 Nonlinear differential equations	6	0	0	0
总计 Total	56	0	0	0

五、教学方法 Teaching Methodology

注：可根据实际情况增减行数或修改内容

Note: Please add/reduce linesor revise content based on subject.

勾选 Check	教学方法与特色 Teaching Methodology & Characters
☑	多媒体教学：基于信息化设备的课堂教学 Multi-media-basedlecturing
☑	实践能力传授：理论与行业、实际案例相结合

	Combining theory with industrial practical problems
☑	课程思政建设：知识讲授与德育相结合 Knowledgedeliverywithethiceducation
□	PBL 教学：问题驱动的分组学习与交流 Problem-basedlearning
□	其他:单击或点击此处输入文字。 Other:单击或点击此处输入文字。

六、成绩评定 Assessment

注：可根据实际情况增减行数或修改内容

Note: Please add/reduce linesor revise content based on subject.

考核环节: Assessment Content	平时 Behavior	环节负责人: Director	刘超
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	平时成绩，以学生平时课堂表现、课堂教师随机提问，学生平时作业完成情况综合评定，其中，学生平时课堂表现、课堂教师随机提问占比 10%, 学生平时作业(课前预习作业、课后作业)完成情况占比 90%. According to instant answer to the teacher's questions, comprehensive report and question performance, the mark is evaluated, where question performance and instant answer accounts for 10%, assignments performance (pre-lecture and post-lecture) accounts for 90%.		

考核环节: Assessment Content	期末 Final	环节负责人: Director	刘超
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	考试（提供重要数学公式），2 小时答题及 10 分钟读题时间 Examination(with some important mathematical equation sheet), two hours and ten minutes reading time.		

七、改进机制 Improvement Mechanism

注：未尽事宜以教学团队以及学院教学指导委员会商定为准。

Note: Matters not covered in this file shall be determined by TAB of SSTC, NEU.

教学大纲改进机制 Subject Syllabus Improvement Mechanism			
考核周期(年): Check Period (YR)	4	修订周期(年): Revise Period (YR)	4
改进措施: Measures	课程负责人根据课程教学内容与人才培养目标组织课程团队讨论并修改教学大纲，报分管教学工作副院长审核后由执行院长批准。		

	The subject coordinator shall be responsible for the syllabus discussion and improvement, and the revised version shall be submitted to deputy dean (teaching affairs) for reviewing then to executive dean for approval		
成绩评定改进机制 Assessment Improvement Mechanism			
考核周期(年): Check Period (YR)	1	修订周期(年): Revise Period (YR)	1
改进措施: Measures	课程负责人根据课程教学内容、课堂教学效果以及成绩分布，对课程教学方法和成绩评定环节进行改进，并同步优化评定办法。 The subject coordinator shall revise the syllabus based on the teaching content, effect and result distribution while optimize the assessment measures.		