

数学分析与建模（二） 教学大纲

Mathematical Analysis and Modeling(II) Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100311002	开课学期: Semester	2
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	6	总学时/周: Total Hours/Weeks	96/16
理论学时: LECT. Hours	96	实验学时: EXP. Hours	0
PBL 学时: PBL Hours	0	实践学时/周: PRAC. Hours/Weeks	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	王晓敏 Wang Xiaomin	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） Mathematical Analysis and Modeling (I)		
英文参考教材: EN Textbooks	Mo Huixia, Li Xiaohua, Yuan Jianhua, Yuan Jianhua, Ai Wenbao, Zhu Ping, Advanced Mathematics (II), 2nd Edition, Beijing University of Posts and Telecommunications Press, 2018.		
中文参考教材: CN Textbooks	邓东皋, 尹小玲, 数学分析简明教程(第二版) 下册, 高等教育出版社, 2006. 同济大学数学系, 高等数学(第七版)下册, 高等教育出版社, 2015.		
教学资源: Resources	https://sstc.cloudcampus.com.cn/course/view.php?id=9		
课程负责人(撰写人): Subject Director	王晓敏 Wang Xiaomin	提交日期: Submitted Date	3/3/2023
任课教师(含负责人): Taught by	王晓敏、刘艳杰 Wang Xiaomin, Liu Yanjie		
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期: Approved Date	3/6/2023

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.

<p>整体目标: Overall Objective</p>	<p>数学分析与建模是理工科专业课程的基础，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坚实基础。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。</p> <p>培养学生掌握高等数学的基本理论和方法，尤其是思维方式，掌握知识技能的同时发展创造能力。</p> <p>Mathematical analysis and modeling 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 higher mathematics, especially the way of thinking, master knowledge and skills, and develop creative ability at the same time.</p>	
<p>(1)专业目标: Professional Ability</p>	<p>1-1</p>	<p>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。</p> <p>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.</p>
	<p>1-2</p>	<p>具有扎实的专业基础与学科特长，系统掌握信息通信系统、项目管理与决策及其相关领域专门知识与技能。</p> <p>Excellent engineering literacy, outstanding practical skills in information technology, and capable of creatively solving complex engineering problems in information and communication and related fields through scientific and technological theories and engineering practical methods, as well as the ability of doing academic cutting-edge project research.</p>
	<p>1-3</p>	<p>具有扎实的专业基础与学科特长，系统掌握大数据与人工智能系统、项目管理与决策及其相关领域专门知识与技能。</p> <p>Excellent engineering literacy, outstanding practical skills in information technology, and capable of creatively solving complex engineering problems in computer science and related fields through scientific and technological theories and engineering practical methods, as well as the ability of doing academic cutting-edge project research.</p>
	<p>1-4</p>	<p>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。</p>

		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.
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、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 principles of mathematics and sciences.	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.	1-2, 1-3, 2-1
	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.	1-3, 1-4, 2-1, 2-2

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

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, 1-3, 1-4
知识单元名称 Unit Title	实数连续性 Continuity of Real Numbers		
知识: Knowledge Delivery	实数连续性的等价描述 Equivalent description of continuity of real numbers		
	实数闭区间的致密性 Compactness of closed intervals of real numbers		
	实数的完备性 Completeness of real numbers		
	闭区间上连续函数的性质 Properties of continuous functions on closed intervals		
学习目标: Learning Objectives	了解: Recognize	实数集的上确界、下确界、覆盖的概念 Concepts of supremum, infimum and cover of real number sets	
	理解: Understand	确界原理、单调有界原理、有限覆盖定理、区间套定理、致密性定理、柯西收敛原理的相互等价性 The mutual equivalence of supremum and infimum principle, monotone bounded principle, finite covering theorem, nested interval theorem, compactness theorem and Cauchy convergence principle	
	掌握: Master	上述定理相互等价的证明思路和方法 Ideas and methods for proving the equivalence of the above theorems 闭区间上连续函数的性质的证明思路和方法 Ideas and methods for proving the properties of continuous functions on closed intervals	
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.		
重点: Key Points	确界定理、单调有界原理、有限覆盖定理 supremum and infimum theorem, monotone bounded principle, finite covering theorem		
难点: Focal points	上述定理相互等价的证明思路和方法 Ideas and methods for proving the equivalence of the above theorems		

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-1, 1-2, 1-3, 1-4
知识单元名称 Unit Title	数项级数 Series with Constant Terms		
知识点: Knowledge Delivery	数项级数的收敛与发散 Convergence and divergence of a series with constant terms		
	级数的性质 Properties of series 数项级数收敛的必要条件 A necessary condition for convergence of a series with constant terms		
	正项级数收敛性的判别法 Convergence tests for series with positive terms		
	柯西收敛原理 Cauchy convergence principle		
	一般项级数的收敛性判别法 General series and tests for convergence		
学习目标: Learning Objectives	了解: Recognize	数项级数收敛、发散以及收敛级数的和的概念 Concept of convergence, divergence of series and the sum of convergent series	
	理解: Understand	级数的性质 Properties of series 狄利克雷判别法和阿贝尔判别法 Dirichlet test and Abel test 无穷级数与广义积分之间的共同点与差异 Similarities and differences between infinite series and generalized integral	
	掌握: Master	正项级数收敛性的判别法 Convergence tests for series with positive terms 莱布尼茨判别法 Leibniz test	
德育目标 Moral Objectives	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.		
重点: Key Points	正项级数收敛性的判别法 Convergence Tests for Series with Positive Terms 莱布尼茨判别法 Leibniz test		
难点: Focal points	柯西收敛原理 Cauchy convergence principle		

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-1, 1-2, 1-3, 1-4
知识单元名称 Unit Title	函数项级数 Functional Series		
知识点: Knowledge Delivery	函数项级数的收敛域与和函数 Convergence domain and sum function of functional series		
	函数项级数的一致收敛的概念 Concept of uniform convergence of functional series		
	一致收敛函数项级数的性质 Properties of uniformly convergent functional series		

	函数项级数的一致收敛性判别法 Uniform convergence tests for functional series		
	幂级数及其收敛半径、收敛域 Power series, radius of convergence、 domain of convergence of power series		
	函数可展开为泰勒级数的充分必要条件 Necessary and sufficient conditions for the function to be expanded into Taylor series		
	几个基本初等函数的麦克劳林展开式 Maclaurin expansion of some basic elementary functions		
	傅立叶级数 Fourier series		
学习目标: Learning Objectives	了解: Recognize 函数项级数的收敛域与和函数的概念 Concepts of convergence domain and sum function of functional series 傅立叶级数的概念和狄利柯雷定理 Concept of Fourier series and Dirichlet theorem		
	理解: Understand 函数项级数的一致收敛的概念 Concept of uniform convergence of functional series 函数展开成傅立叶级数 Find the Fourier series of a function		
	掌握: Master 函数项级数一致收敛性判别法 Uniform convergence tests for functional series 一致收敛函数项级数的和函数的分析性质 Analytical properties of the sum function of a uniformly convergent series with function terms 幂级数收敛半径及收敛域的求法 Methods for finding the convergence radius and convergence region of power series 基本初等函数的麦克劳林展开式 Maclaurin expansion of basic elementary functions		
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		
重点: Key Points	函数项级数的一致收敛性判别法 Uniform convergence test for functional series 函数展开成幂级数 Finding the power series of a function		
难点: Focal points	函数项级数的一致收敛性判别法 Uniform convergence tests for functional series		
知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-1, 1-2, 1-3, 1-4
知识单元名称 Unit Title	向量与空间解析几何 Vectors and Solid Analytic Geometry		

知识点: Knowledge Delivery	向量 Vectors	
	向量的乘积 Products of vectors	
	平面与空间直线的方程 Equations for planes and lines in space	
曲面与空间曲线 Surfaces and space curves		
学习目标: Learning Objectives	了解: Recognize	曲面和空间曲线方程的概念 Concepts of surfaces and space curves
	理解: Understand	向量的数量积 Scalar product of two vectors 向量的向量积 Vector product of two vectors
	掌握: Master	平面方程与空间直线方程的求法 Finding the equations of planes and lines in space 常用二次曲面 Common quadric surface
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.	
重点: Key Points	平面方程与空间直线方程的求法 Finding the equations of planes and lines in space	
难点: Focal points	曲面与空间曲线的画法 Drawing of surface and space curve	

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-1, 1-2, 1-3, 1-4
知识单元名称 Unit Title	多元函数微分法及其应用 Differential Calculus of Multi-variable Functions and its Application		
知识点: Knowledge Delivery	多元函数的极限与连续性 Limit and continuity of multi-variable functions		
	偏导数与全微分 Partial derivatives and total differentials		
	多元函数的求导法则 Derivation rules of multi-variable functions		
	多元函数微分学的几何应用 Geometric application of differential calculus of multi-variable functions		
	方向导数和梯度 Directional derivatives and the gradient		
	多元函数的极值与最值 Extreme value、maxima and minima of multi-variable functions		
学习目标: Learning Objectives	了解: Recognize	多元函数的极限与连续的概念与性质 Concepts and properties of limit and continuity of multi-variable functions 偏导数和全微分的概念 Concepts of partial derivatives and total differentials of multi-variable functions	

	理解: Understand	全微分形式的不变性 Invariance of the total differential form 隐函数的微分法 Differentiation of implicit functions 空间曲线的切线与法平面、曲面的切平面、法线 Tangent line and normal plane to a space curve、 Tangent planes and normal lines to a surface
	掌握: Master	偏导数和全微分的求法 Finding the partial derivative and total differential 二元函数的极值和条件极值 Finding local extreme values and constrained extreme values of a function of two variables
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.	
重点: Key Points	偏导数和全微分的求法 Finding the partial derivative and total differential 二元函数的极值和条件极值 Finding local extreme values and constrained extreme values of a function of two variables	
难点: Focal points	多元函数极限的证明及求法 Proof and solution of the limit of multi-variable functions 多元函数的高阶偏导数 Higher-order partial derivatives of multi-variable functions	

知识单元序号: Knowledge Unit No.	6	支撑教学目标: SLOs Supported	1-1, 1-2, 1-3, 1-4
知识单元名称 Unit Title	重积分 Multiple Integrals		
知识点: Knowledge Delivery	重积分的概念与性质 Concepts and properties of multiple integrals		
	重积分的计算 Calculation of multiple integrals		
	重积分的应用 Applications of multiple integrals		
	含参变量的积分 Integrals with parametric variables		
学习目标: Learning Objectives	了解: Recognize	重积分的概念 Concepts of multiple integrals	
	理解: Understand	重积分的性质 Properties of multiple integrals	
	掌握: Master	二重积分的计算 Calculation of double integrals 三重积分的计算 Calculation of triple integrals	

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.
重点: Key Points	直角坐标、极坐标下二重积分的计算 Double integrals in rectangular and polar coordinates 直角坐标、柱坐标、球坐标下三重积分的计算 Triple integrals in rectangular、cylindrical and spherical coordinates
难点: Focal points	三重积分的计算 Calculation of triple integrals

知识单元序号: Knowledge Unit No.	7	支撑教学目标: SLOs Supported	1-1, 1-2, 1-3, 1-4
知识单元名称 Unit Title	曲线积分与曲面积分 Line Integrals and Surface Integrals		
知识点: Knowledge Delivery	对弧长的曲线积分、对坐标的曲线积分 Line integrals with respect to arc length、Line integrals with respect to coordinates		
	格林公式 Green's formula		
	对面积的曲面积分、对坐标的曲面积分 Surface integrals with respect to surface area、surface integrals with respect to coordinates		
	高斯公式，斯托克斯公式 Gauss formula and Stokes formula		
学习目标: Learning Objectives	了解: Recognize	两类曲线积分、两类曲面积分的概念和性质 Concepts and properties of two kinds of line integral and two kinds of surface integral	
	理解: Understand	散度和旋度的概念和计算 Concept and calculation of divergence and rotation	
	掌握: Master	两类曲线积分、两类曲面积分的计算 Calculation of two kinds of line integral and two kinds of surface integral 格林公式、高斯公式、斯托克斯公式 Green formula、Gauss formula and Stokes formula	
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.		
重点: Key Points	两类曲线积分、两类曲面积分的计算 Calculation of two kinds of line integral and two kinds of surface integral		
难点: Focal points	积分与路径无关的等价条件 Equivalent conditions of path independence of line integrals		

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
实数连续性 Continuity of real numbers	10	0	0	0
数项级数 Series with Constant Terms	12	0	0	0
函数项级数 Functional Series	10	0	0	0
向量代数与空间解析几何 Vectors and Solid Analytic Geometry	10	0	0	0
多元函数微分法及其应用 Differential Calculus of Multi-variable Functions and its Application	20	0	0	0
重积分 Multiple Integrals	14	0	0	0
曲线积分与曲面积分 Line Integrals and Surface Integrals	20	0	0	0
总计 Total	96	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 lines or revise content based on subject.

勾选 Check	教学方法与特色 Teaching Methodology & Characters
<input checked="" type="checkbox"/>	课堂教学：板书与多媒体相结合、以板书为主 Combination of blackboard writing and multimedia, mainly blackboard writing
<input checked="" type="checkbox"/>	实践能力传授：理论与行业、实际案例相结合 Combining theory with industrial practical problems
<input checked="" type="checkbox"/>	课程思政建设：知识讲授与德育相结合 Knowledge delivery with ethic education
<input type="checkbox"/>	PBL 教学： Problem-based learning
<input type="checkbox"/>	其他： Other:

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 lines or revise content based on subject.

考核环节: Assessment Content	平时 Behavior	环节负责人: Director	刘艳杰 Liu Yanjie
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	30
考核方式: Measures	<p>平时成绩，以学生平时课堂出勤、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，学生平时课堂出勤、表现、课堂教师随机提问占比 20%，学生平时作业完成情况占比 80%。</p> <p>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%.</p>		

考核环节: Assessment Content	期中 Mid-term	环节负责人: Director	刘艳杰 Liu Yanjie
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	20
考核方式: Measures	<p>以闭卷形式进行 2 次阶段小测验（threshold test），每次 90 分钟。每次考试成绩占期中总成绩 50%。</p> <p>Two threshold tests in the form of closed book, with 90 minutes each time. Each test score accounts for 50% of the total mid-term score.</p>		

考核环节: Assessment Content	期末 Final	环节负责人: Director	王晓敏
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	<p>闭卷考试，考试时间 120 分钟。</p> <p>Closed book examination, 120 minutes.</p>		

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	<p>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。</p> <p>The subject coordinator shall be responsible for the syllabus discussion</p>		

	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	<p>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。</p> <p>The subject coordinator shall revise the syllabus based on the teaching content, effect and result distribution while optimize the assessment measures.</p>		