

高等数学建模（一） 教学大纲

Mathematical Modelling (I) Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100311003	开课学期: Semester	1
课程分类: Category	公共基础 GF	所属课群: Section	专业平台 MT
课程学分: Credit Points	5	总学时/周: Total Hours/Weeks	80/14
理论学时: LECT. Hours	80	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	适用专业: Stream	CST/CE
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	李晓奇	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	无 None		
英文参考教材: EN Textbooks	1. Mo Huixia, Li Xiaohua, Yuan Jianhua, Yuan Jianhua, Ai Wenbao, Zhu Ping, Advanced Mathematics (I) & (II), 2nd Edition, Beijing University of Posts and Telecommunications Press, 2018. 2. Ron Larson, Elementary Linear Algebra, Cengage Learning, 2017.		
中文参考教材: CN Textbooks	同济大学数学系,高等数学(第七版)上、下册, 高等教育出版社, 2014 同济大学数学系,线性代数(第六版), 高等教育出版社, 2007		
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	李晓奇 Li Xiaoqi	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	郭静梅、李晓奇、周蕊 Guo Jingmei, Li Xiaoqi, Zhou Rui		
审核人: Checked by	韩鹏	批准人: Approved by	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.

<p>整体目标: Overall Objective</p>	<p>高等数学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、兴趣和能力的。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 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>(2) 德育目标: Essential Quality</p>	<p>2-1</p>	<p>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。</p> <p>Understand the significant meanings of the advanced mathematics in depicting the practical engineering problems.</p>
	<p>2-2</p>	<p>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。</p> <p>Understand the technology development, key techniques and the core competitiveness in the area of the China engineering in the world.</p>
	<p>2-3</p>	<p>培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难</p>

		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、工程知识:能够将数学、自然科学、工程基础和专业知 识用于解决复杂工程问题。 Identify, formulate, research literature and analyze complex practical problems reaching substantiated conclusions using first principles of mathematics and sciences.	1-1 掌握数学、自然科学、工程基础和专业知 识,并使用其建立正确的数学、物理学等模型以解释复杂工程问题。 Mastery of mathematics, natural science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems with the establishment of correct mathematical and physical models.	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 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. 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。	1-1, 1-2, 2-1 到 2-7

	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.	
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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

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	矩阵乘法和行列式 Matrix multiplication and determinants		
知识点: Knowledge Delivery	线性方程组介绍, 高斯消元法解方程组, 矩阵的定义 Introduction to linear equation system, Solving equations by Gauss elimination, Definition of matrix		
	矩阵的初等变换, 矩阵的运算 Elementary transformation of matrix, Operations of matrix		
	矩阵运算性质, 矩阵的逆 Properties of matrix Operations, Inverse of matrix		
	初等矩阵, 行列式定义, 行列式的运算及性质 Elementary matrix, Definition of determinant, Operations and properties of determinant		
学习目标: Learning Objectives	了解: Recognize	行列式定义, 线性方程组 Definition of determinant, linear equation system	
	理解: Understand	高斯消元法, 初等矩阵, 找矩阵的逆, 初等矩阵的性质 Gauss elimination, Elementary Matrix, Finding the inverse of a matrix, Properties of the elementary matrices;	
	掌握: Master	矩阵运算性质, 行列式的运算及性质 Properties of matrix operations, Operations and properties of determinant	
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.		
	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"		

重点: Key Points	高斯消元法, 找矩阵的逆 Gauss elimination, Finding the inverse of a matrix
难点: Focal points	矩阵运算性质, 行列式的运算和性质 Property of matrix operation, operation and property of determinant

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	向量空间与线性相关/无关 Vector space and linear dependence /independence		
知识点: Knowledge Delivery	向量,向量空间,向量子空间 Vectors, Vector Spaces, Subspaces of Vector Spaces		
	生成集和线性无关, 基和维数 Spanning Sets and Linear Independence, Basis and Dimension;		
	矩阵的秩和线性方程组 Rank of a Matrix and Systems of Linear Equations;		
	坐标和基变换 Coordinates and Change of Basis		
	内积空间, 正交基, 施密特正交化过程 Inner Product Spaces, Orthonormal Bases, Gram-Schmidt Process		
学习目标: Learning Objectives	了解: Recognize	向量,向量空间,向量子空间, Vectors, Vector spaces, Subspaces of Vector Spaces	
		生成集,基和维数 Spanning Sets, Basis and dimension;	
	理解: Understand	坐标和基变换; Coordinates and Change of Basis;	
		内积, 正交和正交集 Inner Products, Orthogonal and Orthonormal Sets;	
	掌握: Master	线性相关和线性无关, Linear dependence and linear independence;	
		矩阵的秩和线性方程组 Rank of a Matrix and Systems of Linear Equations;	
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.		
	2-3 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"		
重点: Key Points	线性相关和线性无关 Linear dependence and linear independence; 矩阵的秩和线性方程组 Rank of a Matrix and Systems of Linear Equations;		

难点: Focal points	施密特正交化过程 Gram-Schmidt Process		
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	线性变换及特征向量 Linear transformation and eigenvector		
知识点: Knowledge Delivery	线性变换的介绍,相似矩阵 introduction to Linear Transformations, Similar Matrices;		
	特征值与特征向量, 对角化 Eigenvalues and Eigenvectors, Diagonalization		
	对称矩阵和正交对角化 Symmetric Matrices and orthogonal Diagonalization		
	实二次型和其矩阵,实二次型的标准型,正定二次型 Real quadratic form and its matrix, Canonical form of real quadratic form, Positive Definite Quadratic Form		
学习目标: Learning Objectives	了解: Recognize	线性变换的定义 Definition of a Linear Transformation	
		对称矩阵的定义 Definition of a Symmetric Matrices;	
		实二次型和其矩阵 Real quadratic form and its matrix; 二次型的对角型 Diagonal form of quadratic form;	
	理解: Understand	对称矩阵的性质 properties of Symmetric Matrices;	
		正交对角化 orthogonal Diagonalization	
	掌握: Master	特征值与特征向量 Eigenvalues and Eigenvectors;	
正交变换转化二次型为对角型 Changing quadratic form into diagonal form by Orthogonal Transformation;			
正定二次型 Positive Definite Quadratic Form			
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.		
	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	找特征值与特征向量 Finding Eigenvalues and Eigenvectors;		
	对称矩阵的性质 properties of Symmetric Matrices; 正交对角化 orthogonal Diagonalization		
难点:	矩阵对角化 Matrix Diagonalizable		

Focal points	正交变换转化二次型为对角型 Changing Quadratic Form into Diagonal Form by Orthogonal Transformation; 正定二次型 Positive Definite Quadratic Form;
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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	函数性质及其与测量和物理结果解释的关系 Functions and their relationship to measurement and the interpretation of physical results		
知识点: Knowledge Delivery	数列极限性质 Limits of Sequences		
	函数极限性质 The Limit of a Function		
	无穷及无穷性质 Infinitesimal and Infinite properties		
	连续函数及其性质 Continuous Functions and its properties		
学习目标: Learning Objectives	了解: Recognize	数列以及函数极限的定义 The definition of limit of a sequence and a function	
	理解: Understand	连续函数的定义以及性质 Definition and properties of continuous functions	
	掌握: Master	无穷及无穷性质 Infinitesimal and Infinite properties	
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	连续函数的定义以及性质 Definition and properties of continuous functions		
难点: Focal points	无穷及无穷性质 Infinitesimal and Infinite properties		

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	导数与微分 Derivative and Differential		
知识点: Knowledge Delivery	导数的概念以及应用 Concept of Derivatives and its applications		
	求导数以及高阶导数的法则 Rules of Finding Derivatives, Higher Order Derivatives		
	隐函数以及参数方程的求导数法则		

	Derivation of Implicit Functions and Parametric Equations	
学习目标: Learning Objectives	了解: Recognize	导数的概念以及应用 Concept of Derivatives and its applications
	理解: Understand	求导数以及高阶导数的法则 Rules of Finding Derivatives, Higher Order Derivatives
	掌握: Master	隐函数以及参数方程的求导数法则 Derivation of Implicit Functions and Parametric Equations
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.	
	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	求导数以及高阶导数的法则 Rules of Finding Derivatives, Higher Order Derivatives	
难点: Focal points	隐函数以及参数方程的求导数法则 Derivation of Implicit Functions and Parametric Equations	

知识单元序号: Knowledge Unit No.	6	支撑教学目标: SLOs Supported	1-1, 1-2
知识单元名称 Unit Title	微分中值定理及其应用 Mean value theorem and its applications		
知识点: Knowledge Delivery	罗尔定理、微分中值定理 Rolle theorem, Mean value theorem		
	洛必达法则、泰勒定理 L'hospital's rule, Taylor theorem		
	极值及其应用问题 Extreme value and its applications		
	函数单调性及其应用 Monotonicity and its applications		
学习目标: Learning Objectives	了解: Recognize	罗尔定理、微分中值定理 Rolle theorem, Mean value theorem	
	理解: Understand	极值及其应用问题 Extreme value and its applications	
	掌握: Master	洛必达法则 L'hospital's rule	
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	函数单调性及其应用 Monotonicity and its applications
难点: Focal points	洛必达法则 L'hospital's rule

知识单元序号: Knowledge Unit No.	7	支撑教学目标: SLOs Supported	1-1, 1-2
知识单元名称 Unit Title	积分及其性质 Integral and its properties		
知识点: Knowledge Delivery	不定积分的概念与性质 Concepts and Properties of Indefinite Integrals		
	不定积分的求法 Operation Rules of Indefinite Integrals		
	定积分的概念与性质 Concepts and Properties of Definite Integrals		
	微积分基本定理 The Fundamental Theorems of Calculus		
	定积分的换元和分部积分法 Integration by Substitution and Parts in Definite Integrals		
	反常积分 Improper Integrals		
	定积分的几何应用 Applications of Definite Integrals		
学习目标: Learning Objectives	了解: Recognize	不定积分、定积分的概念与性质 Concepts and Properties of Indefinite Integrals and Integrals	
	理解: Understand	不定积分的求法 Operation Rules of Indefinite Integrals 反常积分 Improper Integrals	
	掌握: Master	微积分基本定理 The Fundamental Theorems of Calculus 定积分的换元和分部积分法 Integration by Substitution and Parts in Definite Integrals 定积分的几何应用 Applications of Definite Integrals	
德育目标	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		

Moral Objectives	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.
	2-6 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	不定积分的求法 Operation Rules of Indefinite Integrals
难点: Focal points	微积分基本定理 The Fundamental Theorems of Calculus 定积分的分部积分法 Integration by Parts in Definite 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
矩阵乘法和行列式 Matrix multiplication and determinants	13	0	0	0
向量空间与线性相关性质 Vector space and linear dependence properties	9	0	0	0
线性变换及特征向量 Linear transformation and eigenvector	8	0	0	0
函数极限和连续 Functions limits and continuous functions	14	0	0	0
微分中值定理及其应用 Mean value theorem and its applications	12	0	0	0
导数与微分 Derivative and Differential	6	0	0	0
积分及其性质 Integral and its properties	18	0	0	0
总计 Total	80	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"/>	多媒体教学：基于信息化设备的课堂教学 Multi-media-based lecturing
<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：问题驱动的分组学习与交流 Problem-based learning
<input type="checkbox"/>	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 lines or revise content based on subject.

考核环节: Assessment Content	平时 Behavior	环节负责人: Director	李晓奇, 郭静梅 Li Xiaoqi, Guo Jingmei
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	30
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	期中 Mid-term	环节负责人: Director	李晓奇, 周蕊 Li Xiaoqi, Zhou Rui
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	20
考核方式: Measures	120 分钟 Threshold test, 考试满分 100 分, 考试成绩占 Threshold test 的比例, 与课程知识点学时占总理论学时的比例, 保持一致. 该部分成绩列入期中考试成绩科目。 One hundred and twenty minutes Threshold test, the full mark is 100 mark and the test accounting on the final mark conforms to the same percentage of corresponding theoretical term hour accounting on the whole theoretical term hour. The marks are listed in the mid-term exam		

	score.
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考核环节: Assessment Content	期末 Final	环节负责人: Director	郭静梅 Guo Jingmei
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, 2 小时答题时间 Examination, and the examinations lasts for two hour 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.		