

# 线性代数 教学大纲

## Linear Algebra

## Subject Syllabus

### 一、课程信息 Subject Information

课程编号: Subject ID	EQV-AS-37233	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	3	总学时/周: Total Hours/Weeks	48/12
理论学时: LECT. Hours	48	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	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	刘建波 Liu Jianbo	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. Steven J. Leon, Linear Algebra with Applications, Ninth Edition, Chine Machine Press, 2020. 2. Ron Larson, Elementary Linear Algebra, Cengage Learning, 2017. 3. Sun Xiaojuan, Linear Algebra, Beijing University of Posts and Telecommunications Press, 2018.		
中文参考教材: CN Textbooks	1. 史蒂文 J. 利昂 著, 张文博, 张丽静 译, 线性代数, 机械工业出版社, 2020. 2. 北京大学数学系, 高等代数(第四版), 高等教育出版社, 2013. 3. 刘建波, 大学教材全解-高等代数, 延边大学出版社, 2013. 4. 同济大学数学系, 线性代数(第五版), 高等教育出版社, 2007.		
教学资源: Resources	<a href="https://sstc.cloudcampus.com.cn/course/view.php?id=9">https://sstc.cloudcampus.com.cn/course/view.php?id=9</a>		
课程负责人(撰写人): Subject Director	刘建波 Liu Jianbo	提交日期: Submitted Date	3/8/2023
任课教师(含负责人): Taught by	刘建波 Liu Jianbo		
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期: Approved Date	3/10/2023

## 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>线性代数作为一种基本的数学工具在数学领域及其他科学领域，如控制理论、数值分析、信息与科学技术、最优化理论、管理科学等学科都有十分重要的应用。通过这门课程，学生可以了解矩阵分析在人类生活和社会发展中的重要地位和作用以及其深远的发展历史。同时学生能够系统掌握代数中的基本概念、基本理论和基本论证方法，提高学生从事科学研究的能力，为进一步学习其它专业课和从事专业研究打下基础。在奠定数学科学知识基础的同时，培养学生基本运算能力、抽象思维能力、逻辑推理能力和运用所学的知识分析问题、解决问题的能力。培养科学精神、创新意识与应用意识。能够在多学科背景下的团队中承担个体、团队成员以及负责人的角色。</p> <p>Linear algebra, as a basic mathematical tool, has been applied very important in mathematics and other scientific fields, such as control theory, numerical analysis, information and science and technology, optimization theory, management science and other disciplines. Through this course, students can understand the important position and role of matrix analysis in human life and social development as well as its far-reaching development history. At the same time, students can systematically master the basic concepts, basic theories and basic demonstration methods of algebra, improve the ability of students to engage in scientific research, and lay a foundation for further learning other specialized courses and engaging in professional research. At the same time of laying the foundation of mathematical science knowledge, the students' basic operation ability, abstract thinking ability, logical reasoning ability and the ability to use the learned knowledge to analyze and solve problems will be cultivated.</p> <p>Cultivate scientific spirit, innovation consciousness and application consciousness. Ability to work as an individual, a team member and a leader in a multidisciplinary team.</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>Have a solid professional foundation and subject expertise, master the information and communication system, project</p>

		management and decision-making and related fields of expertise and skills.
	1-3	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。 Have a solid professional foundation and subject expertise, systematically master big data and artificial intelligence systems, project management and decision-making and related fields of expertise and skills.
	1-4	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。 Have excellent technical literacy and outstanding practical ability of applied statistics, have the ability to creatively solve complex problems through scientific and technological theories and methods in Applied Statistics and related fields, and engage in the research of academic frontier problems.
(2) 德育目标: Essential Quality	2-1	融入辩证唯物主义哲学思想,提升学生对概念、定理的认识深度和对本质的把握,促进学生辩证思维能力的培养。 Integrate dialectical materialism philosophy thought, improve students' understanding depth of concept, theorem and grasp of essence, and promote the cultivation of students' dialectical thinking ability.
	2-2	线性代数的理论不仅渗透到了数学的许多分支中,而且在理论物理、理论化学、工程技术、国民经济、生物技术、航天、航海等领域中都有着广泛的应用。该课程对于培养学生的逻辑推理和抽象思维能力、空间直观和想象能力具有重要的作用。 The theory of linear algebra has not only penetrated into many branches of mathematics, but also has a wide range of applications in theoretical physics, theoretical chemistry, engineering technology, national economy, biotechnology, aerospace, navigation and other fields. This course plays an important role in cultivating students' logical reasoning and abstract thinking ability, spatial intuition and imagination ability.
<b>课程教学目标与毕业要求的对应关系 Matrix of GA &amp; SLOs</b>		
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。 Science knowledge: have a solid mathematical foundation, be able to use	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。 Have strong deductive reasoning ability, accurate calculation ability, analytical and	1-1, 1-2

mathematics, natural science and professional knowledge to solve complex practical problems.	inductive ability, abstract thinking ability, master mathematics, natural science and related professional knowledge, and use it to establish correct mathematical, physical and other models to explain complex practical problems.	
<p>1、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。</p> <p>Problem analysis: with the help of the basic principles, methods and means of applied statistics, we can identify, express and analyze complex practical problems through literature research, so as to obtain effective conclusions.</p>	<p>2-1 能运用应用统计学的基本原理分析、识别和阐述与本专业相关的复杂实际问题。</p> <p>Capable of analyzing, identifying and elaborating complex practical problems related to this major with the applying of the basic principles of Applied Statistics.</p>	1-2, 1-3, 2-1
	<p>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。</p> <p>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.</p>	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

#### (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, 1-3, 1-4
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	矩阵的定义 Definition of matrix		
	矩阵的初等变换，行最简型矩阵，矩阵的运算 Fundamental transformation of matrix, The simplest row form of matrix, Computation of matrix		
	分块矩阵，矩阵运算性质，矩阵的逆 Block matrix, properties of matrix computation, Inverse of matrix		
	初等矩阵；行列式定义，行列式的运算 Fundamental matrix, Definition of determinant, Computation of determinant		

学习目标: Learning Objectives	了解: Recognize	行列式定义, 分块矩阵定义, 线性方程组定义 Definition of determinant, block matrix, linear equation system
	理解: Understand	初等变换方法, 矩阵的逆求法 Fundamental transformation method, Method of inverse of matrix
	掌握: Master	矩阵运算性质, 行列式的运算 Properties of matrix computation, Computation 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.	
重点: Key Points	初等变换方法, 矩阵的逆求法 Fundamental transformation method, Method of inverse of matrix	
难点: Focal points	矩阵运算性质, 行列式的运算 Properties of matrix computation, Computation 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	线性方程组和向量空间 Systems of linear equations and Vector spaces		
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;	
		施密特正交化过程 Gram-schmidt process	
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, 2-1, 2-2
知识单元名称 Unit Title	线性变换 Linear transformation		
知识点: Knowledge Delivery	线性变换的定义 The definition of a linear transformation		
	线性变换的矩阵表示 A matrix representation of a linear transformation		
	线性变换的矩阵相似 The matrix similarity of linear transformations		
	线性变换的值域与核 Range and kernel of linear transformation		
学习目标: Learning Objectives	了解: Recognize	线性变换的定义 The definition of a linear transformation	
	理解: Understand	线性变换的标准矩阵表示，值域与核 Standard matrix representation of linear transformations, range and kernel	
	掌握: Master	矩阵表示定理及应用以及相似性 Matrix representation theorem and its application and similarity	
德育目标 Moral Objectives	培养学生用哲学思辨立场、观点和方法分析解决问题，能够提高学生的创新能力和应用意识。 Cultivating students to analyze and solve problems with philosophical thinking standpoint, viewpoint and method can improve students' innovation ability and application consciousness.		
重点: Key Points	矩阵表示定理及其应用 Matrix representation theorem and its application		
难点: Focal points	同一线性变换在不同基下的矩阵表示是相似的 The matrix representation of the same linear transformation on different bases is similar		

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-4, 2-1, 2-2
知识单元名称 Unit Title	特征值与特征向量 Eigenvalues and Eigenvectors		
知识点: Knowledge Delivery	特征值与特征向量的定义 Definitions of eigenvalues and eigenvectors		
	对角化 Diagonalization		
	矩阵可对角化的条件 Conditions for diagonalization of matrices		
	相似矩阵和正交对角化 Symmetric matrices and orthogonal diagonalization		
学习目标: Learning Objectives	了解: Recognize	特征值与特征向量的定义 Definitions of eigenvalues and eigenvectors	
	理解: Understand	对角化 Diagonalization	
	掌握: Master	矩阵可对角化的条件 The condition of matrix diagonalization 相似矩阵和正交对角化 Symmetric matrices and orthogonal diagonalization	
德育目标 Moral Objectives	<p>在计算机日益普及的今天，解大型线性方程组、求矩阵的特征值、特征向量等已经成为工程技术人员经常遇到的课题，因此本课程所介绍的方法广泛地应用于各个学科，这就要求工科学生必须具备有线性代数基本理论知识，并熟练地掌握它的方法。为今后学习代数学和其它学科及进一步提高打下必要的数学基础。</p> <p>Today, the increasing popularity of computer, large linear equations, matrix eigenvalue and eigenvector and so on has become a subject of engineering and technical personnel often encountered, so this course introduced methods widely used in various disciplines, this requires engineering students must have the basic theory of linear algebra knowledge, and skillfully master the methods of it. For the future study of algebra and other subjects and further improve to lay the necessary mathematical foundation.</p>		
重点: Key Points	矩阵可对角化的条件 The condition of matrix diagonalization		
难点: Focal points	相似矩阵和正交对角化 Symmetric matrices and orthogonal diagonalization		

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-4, 2-1, 2-2
知识单元名称 Unit Title	二次型 Quadratic Forms		
知识点: Knowledge Delivery	实二次型和其矩阵 Real quadratic form and its matrix		
	实二次型的标准型 Canonical form of real quadratic form		
	正定二次型和正定矩阵 Positive definite quadratic form and matrices		

	二次型的应用 The application of the quadratic form	
学习目标: Learning Objectives	了解: Recognize	实二次型和其矩阵 Real quadratic form and its matrix
	理解: Understand	实二次型的标准型 Canonical form of real quadratic form 正定二次型和正定矩阵 Positive definite quadratic form and matrices
	掌握: Master	二次型的应用 The application of the quadratic form 正定二次型和正定矩阵 Positive definite quadratic form and matrices
德育目标 Moral Objectives	掌握数学的基本思维和科学方法, 树立科学思想, 崇尚科学精神。 Master the basic thinking and scientific method of mathematics, establish scientific thought and advocate scientific spirit.	
重点: Key Points	二次型的应用 The application of the quadratic form 正定矩阵 Positive definite quadratic form and matrices	
难点: Focal points	正定矩阵 Positive definite quadratic form and matrices	

#### 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.	课外实践 PBL	集中实践 PRAC.
矩阵和行列式 Matrices and determinants	10	0	0	0
线性方程组和向量空间 Systems of linear equations and Vectors space	12	0	0	0
线性变换 Transformations	12	0	0	0
特征值和特征向量 Eigenvalues and Eigenvectors	8	0	0	0
二次型 Quadratic Forms	6	0	0	0
总计 Total	48	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 checked="" 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	刘建波 Liu Jianbo
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%.</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	刘建波 Liu Jianbo
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>120 分钟 Threshold test, 共计 2 次, 每次考试满分 100 分, 每次考试成绩占 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。</p> <p>One hundred and twenty minutes Threshold text, there are totally two tests, the full mark is 100 mark and percentage of each 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.</p>		

考核环节: Assessment Content	期末 Final	环节负责人: Director	刘建波 Liu Jianbo
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	满分 100 分，通过批阅期末考试试卷给出学生成绩。 A full score of 100 will be given by marking the final examination papers		

## 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 person in charge of the course shall organize the course team to discuss and revise the syllabus according to the course teaching content and talent training objectives, which shall be submitted to the vice president in charge of teaching for approval by the executive president.		
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。 According to the course teaching content, classroom teaching effect and score distribution, the person in charge of the course improves the course teaching method and score evaluation link, and optimizes the evaluation method at the same time.		