东北大学秦皇岛分校本科课程教学大纲

一、课程基本信息

<table>
<tr><td>开课单位</td><td colspan="3">悉尼智能科技学院</td><td>课程代码</td><td colspan="5">3100312003</td></tr>
<tr><td>中文名称</td><td colspan="8">线性代数（全英课程）</td></tr>
<tr><td>英文名称</td><td colspan="8">Linear Algebra</td></tr>
<tr><td>总学时</td><td>48</td><td rowspan="2">理论学时</td><td rowspan="2">48</td><td rowspan="2">实验学时</td><td rowspan="2">0</td><td rowspan="2">上机学时</td><td rowspan="2">0</td><td rowspan="2">设计学时</td><td rowspan="2">0</td><td rowspan="2">课外学时</td><td rowspan="2">0</td></tr>
<tr><td>学　分</td><td>3</td></tr>
<tr><td>课程类型</td><td colspan="8">☑理论课程　☐理论（含实验）课程　☐实践类课程</td></tr>
<tr><td>课程类别</td><td colspan="8">☐通识类　☑学科基础类　☐专业方向类　☐实践类</td></tr>
<tr><td>适用专业</td><td colspan="8">应用统计学</td></tr>
<tr><td>先修课程</td><td colspan="8">无</td></tr>
<tr><td>建议开课学期</td><td colspan="8">☑1-1 ☐1-2 ☐2-1 ☐2-2 ☐3-1 ☐3-2
☐4-1 ☐4-2 ☐5-1 ☐5-2 ☐*（代表每学期都开设）</td></tr>
<tr><td>考核方式</td><td colspan="3">☑考试 ☐考查</td><td>成绩分制</td><td colspan="4">☑百分制 ☐五级制 ☐二级制</td></tr>
<tr><td>使用教材</td><td colspan="8">1. Sun Xiaojuan, Linear Algebra, Beijing University of Posts and Telecommunications Press, 2018.</td></tr>
<tr><td>参考书及教学资源</td><td colspan="8">1. Steven J. Leon, Linear Algebra with Applications, Ninth Edition, Chine Machine Press, 2020.
2. Ron Larson, Elementary Linear Algebra, Cengage Learning, 2017.
3. 同济大学，线性代数（第六版），高等教育出版社，2017.</td></tr>
<tr><td>其他说明</td><td colspan="8">无</td></tr>
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二、课程简介

中文描述

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，培养学生的基本运算能力、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。

English Description

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. Cultivate scientific spirit, innovation consciousness and application consciousness. Ability to work as an individual, a team member and a leader in a multidisciplinary team.

三、课程目标

1、知识目标：

1-1：深刻理解二阶与三阶行列式的定义，掌握 n 阶行列式的定义，行列式的性质，熟练掌握计算行列式的方法和技巧。

1-2：熟练掌握矩阵的运算及运算性质，深刻理解逆矩阵的定义及性质，理解克拉默法则，掌握矩阵分块法的应用。

1-3：理解矩阵的初等变换法及初等变换法的作用，熟练掌握矩阵的秩的定义、求矩阵的秩的方法，熟练掌握判定线性方程组的解的方法。

1-4：深刻理解向量组、线性组合、线性相关的概念，掌握向量组的线性相关的判定方法，熟练掌握求向量组的秩的方法，熟练掌握线性方程组的解的结构，理解向量空间、过渡矩阵的概念。

1-5：理解向量的内积、长度及正交性等概念，熟练掌握矩阵的特征值与特征向量的求法，深刻理解相似矩阵二次型的定义，熟练掌握矩阵与对称矩阵相似化的方法、二次型标准化的方法。

2、能力目标：

2-1：系统地掌握本课程的基本概念、基本定理和基本方法，为学习后续课程和进一步获得数学知识奠定必要的数学基础。

2-2：锻炼学生的抽象思维和逻辑思维能力，培养学生运用数学知识和数学技术解决实际问题能力，启迪学生的创造性思维和创新，培养学生的探索精神和创新能力，培养学生的数学素养和科学素质。

3、德育/素养目标：

3-1：能够使学生运用马克思主义基本立场、观点和方法分析问题和解决问题的能力、认识世界和改造世界的能力。

3-2：培养大学生的理想信念、价值取向、政治信仰、社会责任等，使学生能够树立正确的人生观、价值观，使他们具有精确的推断、全面的观察、理性的思维等本领。

3-3：培养学生的数学素养和科学素质，使学生具有科学观点和科学思维方法，具有自主学习和终身学习的能力。

3-4：通过数学问题解法的多样性，锻炼学生的发散思维能力，培养学生的探索精神和创新能力，注重理论联系实际。

表 1 课程目标与毕业要求的对应关系

毕业要求	指标点	课程目标	关联性（H/M/L）
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	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。	1-1、1-2、1-3、1-4、1-5、2-1、2-2、3-1、3-2、3-3、3-4	H
	1-2：掌握统计调查、统计数据处理、统计分析、计算机与统计软件使用等应用统计学的基本理论、知识与方法，具备采集、处理、分析数据的能力，熟悉预研报告、可行性分析报告、研究方案等文档的撰写规范。	1-2、1-3、1-4、2-1、2-2、3-1、3-2、3-4	M

四、主要教学内容

（一）理论教学

第 0 章：A brief history of linear algebra（支撑课程目标 3-1、3-2、3-3）

【1】知识点：

（1）History of matrices and determinants.

（2）Abel and Galois.

【2】学习目标：

了解：A brief history of linear algebra.

【3】重点内容：

（1）History of matrices and determinants.

（2）Abel and Galois.

【4】难点内容：

（1）History of matrices and determinants.

第 1 章：Matrices and determinants（支撑课程目标 1-1、1-2、1-3、2-1、2-2、3-3、3-4）

【1】知识点：

（1）Definition of matrix.

（2）Elementary operations of matrix, The simplest row form of matrix, Computation of matrix.

（3）Block matrix, Properties of matrix computation, Inverse of matrix.

（4）Elementary matrix, Definition of determinant, Computation of determinant.

（5）Rank of matrix.

【2】学习目标：

了解：the definitions of determinant, block matrix, linear equation system;

理解：the method elementary operations, Method of getting inverse of matrix;

掌握：properties of matrix computation, computation of determinant.

【3】重点内容：

（1）Multiplication of matrices;

（2）Definition and properties of determinant;

（3）Computation of determinant;

（4）The method elementary operations;

（5）Method of getting inverse of matrix.

【4】难点内容：

（1）Properties of matrix computation;

（2）Properties of determinant;

（3）Computation of determinant.

（4）Rank of matrix.

第 2 章：Systems of linear equations（支撑课程目标 1-4、2-1、2-2、3-1、3-3）

【1】知识点：

（1）Vectors, Vector spaces, Subspaces of vector spaces

（2）Spanning sets and linear independence，Basis and dimension.

（3）Maximally linearly independent group.

（4）Rank of a matrix and systems of linear equations.

（5）General solutions of systems of linear equations.

【2】学习目标：

了解：vectors, vector spaces, subspaces of vector spaces, spanning sets, basis and dimension;

理解：maximally linearly independent group, coordinates and change of basis;

掌握：linear dependence and linear independence, rank of a matrix and systems of linear equations, general solutions of systems of linear equations.

【3】重点内容：

（1）Law of solution of linear systems.

（2）Linear dependence and linear independence.

（3）Maximally linearly independent group.

（4）Basis and dimension of vector space.

（5）General solutions of systems of linear equations.

【4】难点内容：

（1）Rank of a matrix and systems of linear equations.

（2）Linear combinations of vectors.

（3）Correlation theorem of linear independence.

（4）Ranks of a matrix and vector group.

【5】思政案例：Through the rank of vector group and the method of maximal linear independent group, the problem is "simplified", and the change of things is seen from the "shape change", so as to feel the abstract beauty, logic beauty and formal beauty of linear algebra. Improve dialectical thinking ability and application ability, establish a scientific attitude of seeking truth from facts and dialectical materialism of the world view.

第 3 章： Eigenvalues and Eigenvectors（支撑课程目标 1-5、2-1、2-2、3-1、3-3）

【1】知识点：

（1）Definitions of eigenvalues and eigenvectors.

（2）Diagonalization.

（3）Conditions for diagonalization of matrices.

（4）Similar matrix.

（5）Orthonormal Basis and Gram-schmidt process.

（6）Real symmetric matrices and orthogonal diagonalization.

【2】学习目标：

了解：the definitions of eigenvalues and eigenvectors, inner product of vectors;

理解：diagonalization, similar matrix, orthonormal Basis;

掌握：conditions for diagonalization of matrices, Gram-schmidt process, real symmetric matrices and orthogonal diagonalization.

【3】重点内容：

（1）Definitions of eigenvalues and eigenvectors.

（2）Similar matrix.

（3）Orthogonal sets and Orthogonal Basis.

（4）Gram-schmidt process.

（5）Real symmetric matrices and orthogonal diagonalization.

【4】难点内容：

（1）Properties of eigenvalues and eigenvectors.

（2）Diagonalization of Square Matrix.

（3）Orthonormal Basis and Gram-schmidt process.

（4）Orthogonal Matrix.

（5）Real symmetric matrices and orthogonal diagonalization.

【5】思政案例：The classic application of eigenvalues in statistics is embodied in principal component analysis (PCA), the work of PCA is to find a set of mutually orthogonal coordinate axes from the original space, and the choice of new coordinate axes is closely related to the data itself. The solution of eigenvalues and eigenvectors of the square matrix is associated with its application in the principal component analysis of statistical analysis method, and then leads to ideological and political elements such as "to solve complex problems, we can first grasp the main contradiction and mathematics comes from life", which effectively promotes students' understanding, mastery, expansion and deepening of curriculum knowledge. The addition of ideological and political elements plays a role in helping students establish a correct outlook on life and values. It points out the direction for students' learning, and students' learning goals are more clear and their learning enthusiasm is higher.

第 4 章：Quadratic Forms（支撑课程目标 1-5、2-1、2-2、3-1、3-3）

【1】知识点：

（1）Real quadratic form and its matrix.

（2）Diagonal form of real quadratic form.

（3）Canonical form of real quadratic form.

（4）Positive definite quadratic form and matrices.

【2】学习目标：

了解：real quadratic form and its matrix;

理解：the diagonal、canonical form of real quadratic form, the definitions of positive definite quadratic form and matrices;

掌握：the methods of diagonalizing real quadratic form, discriminations of positive definite quadratic form and matrices.

【3】重点内容：

（1）The methods of diagonalizing real quadratic form.

（2）Diagonal form of quadratic form.

（3）Discriminations of positive definite quadratic form and matrices.

【4】难点内容：

（1）Changing quadratic form into diagonal form by orthogonal transformation.

（2）Discriminations of positive definite quadratic form and matrices.

五、教学安排与学时分配

This course is taught in a classroom teaching manner. In classroom teaching, we should pay attention to the leading role of values, cultivate the feelings of the family and the country and the concept of strengthening the country, consolidate basic knowledge, enhance the spirit of innovation, and establish a correct outlook on life, world view and values. Table 2 shows the allocation of class hours.

表 2 学时分配表

讲　　课　　内容		学时				
		讲课	实验	上机	设计	课外
第 0 章	**A brief history of linear algebra**	2	0	0	0	0
第 1 章	**Matrices and determinants**	12	0	0	0	0

第 2 章	**Systems of linear equations**	14	0	0	0	0
第 3 章	**Eigenvalues and Eigenvectors**	12	0	0	0	0
第 4 章	**Quadratic Forms**	8	0	0	0	0
小计		48	0	0	0	0
总计	48					

六、教学方法

1、Teaching basic facts, linking theory with practice, combining mathematician stories with the development of mathematical theories, and cultivating students' national self-confidence and innovation ability.

2、The teaching method of combining multimedia courseware, online teaching and traditional teaching is used to give vitality to the classroom.

3、The combination of theoretical teaching and discussion forms mobilizes students' enthusiasm for learning and cultivates students' self-learning ability, teamwork ability and ability to solve practical problems.

七、成绩评定

This course is assessed according to the concept of whole-process monitoring. The course assessment consists of 4 parts, namely attendance, homework, Mid-term test and final exam. The specific requirements and scoring methods are as follows:

1、Attendance: Students are required to participate and sign in all aspects of this course, and are not allowed to be absent. Attendance accounts for 12% of the total grade. 3% will be deducted for each unexcused absence. Talk reminder for 3 absences. Students who are absent from classes (including leave, absenteeism, etc.) and cannot attend classes for more than 1/3 of the total number of hours will not be allowed to take the final exam.

2、Homework: There are 6 in-class assignments in this course, which students must complete independently and submit at the specified time. Assignments account for 18% of the total grade, and each assignment accounts for 3%. If the assignment is not submitted on time or the assignment is plagiarized (similar), the grade of the assignment will be counted as zero.

3、Mid-term test: 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.

Final exam: Closed book, the final exam accounts for 50% of the total score.

Illustrate:

1、The usual grades of this course include attendance, homework and class Q&A, and students who fail the usual grades will be disqualified from the final examination.

2、 If a repeat, remediate, or interprofessional elective student is unable to attend the class due to course conflicts, the student must find an instructor within the first week of the course to explain the situation. The teacher in charge of the class may not deduct the attendance of these students, but must explain to the students that they must participate in other teaching activities such as homework, and if

more than 1/3 of these teaching activities are missing (for whatever reason), they will be disqualified from the final examination.

八、评价及持续改进

1、Syllabus

Assessment cycle: 4 years, Revision cycle: 4 years.

Improvement measures: The course leader organizes all teachers in the course team to discuss and put forward suggestions for improvement, which are approved by the dean of teaching and research after being reviewed by the head of the teaching and research department.

2、Achievement assessment

Assessment period: 1 academic year, evaluation basis: comprehensive analysis of students' final grades.

Improvement measures: According to the distribution of students' final grades, the corresponding content adjustment and optimization will be carried out, and the teaching methods will be improved.

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