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">3100311004</td></tr>
<tr><td>中文名称</td><td colspan="8">高等数学建模（二）</td></tr>
<tr><td>英文名称</td><td colspan="8">Advanced Mathematical Modeling II</td></tr>
<tr><td>总学时</td><td>96</td><td rowspan="2">理论学时</td><td rowspan="2">96</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>6</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">计算机科学与技术</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. 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. Jay.L. Devore, Probability and Statistics for Engineering and the Science, Beijing CENGAGE, 2015.</td></tr>
<tr><td>参考书及教学资源</td><td colspan="8">1. 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
2. 浙江大学数学系,概率论与数理统计(第五版), 高等教育出版社, 2007</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

本课程是为计算机科学与技术专业本科生开设的通识课。内容包括微分方程、级数、解析几何、多元函数微分学、多元函数微分学以及概率论的基本概念、基本理论和基本方法等。本课程为学生学习其它学科以及专业课程打下扎实基础。培养学生较强的计算能力、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。培养学生掌握高等数学的基本理论和方法，尤其是思维方式，使学生在掌握知识技能的同时发展创造能力。

English Description

This course is a general education class designed for undergraduate students majoring in Computer Science and Technology. The content includes differential equations, series, analytic geometry, differential calculus of multivariate functions, and basic concepts, fundamental theories, and essential methods of probability theory. This course lays a solid foundation for students to study other disciplines and professional courses. It aims to develop students' strong computational skills, logical thinking, rigor, and creativity, as well as their awareness, interest, and ability to use mathematical principles and methods to solve practical problems. The course cultivates students' mastery of the basic theories and methods of advanced mathematics, particularly in terms of thinking patterns, enabling students to develop their creative abilities while acquiring knowledge and skills.

三、课程目标

1、知识目标：

1-1：掌握求解一阶和二阶常见类型的微分方程的方法，理解高阶线性微分方程解的性质和解的结构。

1-2：掌握判断常数项级数敛散性的方法、求幂级数收敛域及和函数的方法，掌握函数展开成泰勒级数的充分必要条件及方法，掌握函数展开成傅立叶级数的方法。

1-3：掌握空间曲线的一般方程和参数方程、常用二次曲面方程及其图形，掌握空间曲线曲面的相关几何量的知识。

1-4：理解多元函数的偏导数和全微分的概念，掌握多元函数求导方法，掌握二元函数的极值、条件极值与最值的求法。

1-5：掌握二重、三重积分的概念、性质及计算方法。

1-6：掌握两类曲线积分和两类曲面积分的概念、性质及两类曲面积分的关系，掌握两类曲线积分和两类曲面积分的计算方法。

1-7：理解并掌握概率论的一些基本概念、基本理论和基本方法，并会用相关公式及分布进行计算。

1-8：了解数理统计的基本概念，理解数理统计的基本理论和基本方法，掌握简单的点估计、假设检验和简单线性回归分析的方法。

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：具备运用数学知识和数学技术解决实际问题的能力。

2-3：具有解决实际问题中关于概率计算方面的能力。

2-4：具有通过随机变量的概率分布解决实际问题的能力。

2-5：具有利用统计推断的思想和方法解决实际问题的能力。

3、德育/素养目标：

3-1：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。

3-2：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。

3-3：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。

3-4：引导学生正确处理个人和集体、局部与全局的关系，树立全局观、大局观，培养家国情怀。

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 (H/M/L)
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。	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。	1-1 到 1-3、1-5、1-7、2-1、3-1、3-2	H
2. 问题分析：能够应用数学、自然科学和工程科学的基本原理、方法和手段，识别、表达、并通过文献研究分析复杂工程问题，以获得有效结论。	2.1 能够应用数学、自然科学和工程科学的基本原理、方法和手段，分析、识别、表达本专业相关的复杂工程问题。	1-4、1-6、1-8、2-2、3-3、3-4	M
	2.2 能够应用数学、自然科学和工程科学的基本原理、方法和手段，针对实际复杂	1-1、1-4 到	M

	工程问题设计针对性的技术方案，并综合运用文献、科学理论和技术手段予以解决。	1-7、2-3、2-4、2-5、3-1、3-4	

四、主要教学内容

（一）理论教学

第 1 章：Differential Equations（支撑教学目标 1-1、2-2、3-2）

【1】知识点：

(1) Basic concepts of differential equations.

(2) First-order differential equations.

(3) Reducible differential equations.

(4) Higher-order linear differential equations.

【2】学习目标：

理解：Basic concepts of differential equations; Properties and structures of solutions of higher-order linear differential equations.

掌握：Solving separable differential equations, homogeneous differential equations, first-order linear differential equations and Bernoulli equations; Solving reducible second-order differential equations; Solving second-order and higher-order constant-coefficient linear differential equations.

【3】重点内容：

(1) Methods for solving four types of first-order differential equations.

(2) Methods for solving reducible second-order differential equations.

(3) Methods for solving linear differential equations with constant coefficients.

【4】难点内容：

(1) Transforming differential equations into first-order differential equations for solving..

(2) Methods for solving linear differential equations with constant coefficients.

第 2 章：Series（支撑教学目标 1-2、2-1、3-1）

【1】知识点：

(1) Series with Constant Terms and Their Convergence.

(2) Power Series.

(3) Fourier Series.

【2】学习目标：

理解：Definition of convergent series; Properties of convergent series; Concepts and relationships between absolute and conditional convergence; Necessary and sufficient conditions for a function to be expanded into a Taylor series; Analytical properties of power series and functions.

掌握：Methods for determining the convergence or divergence of series; Methods for finding the sum function of power series; Indirect methods for expanding functions into power series; Methods for expanding functions into Fourier series.

【3】重点内容：

(1) Methods for determining the convergence or divergence of series.

(2) Methods for finding the sum function of power series.

(3) Indirect methods for expanding functions into power series.

【4】难点内容：

(1) Methods for determining the convergence or divergence of series.

(2) Methods for finding the sum function of power series.

【5】思政案例：

By connecting the harmonic series with the tales of the snail climbing a rope and Yugong, a Chinese persevering old man, moving mountains, we conclude that although the distance the snail climbs each day becomes progressively shorter, the sum of these small distances is quite large, even infinitely large. In life, we must never give up. As long as we keep moving forward, we will eventually see hope and achieve our goals. This embodies the spirit of Yugong moving mountains. The story of Yugong's unwavering determination, with his descendants continuing the effort to remove the mountains, reflects the great spirit of the Chinese people who face challenges head-on and work tirelessly. For thousands of years, the story of Yugong moving mountains has been widely celebrated, and the spirit of Yugong has inspired generations of Chinese people to strive and advance bravely.

第 3 章：Analytic Geometry（支撑教学目标 1-3、2-1、3-1、3-2）

【1】知识点：

(1) Vector Algebra.

(2) Equations of Planes and Lines in Space.

(3) Equations of Surfaces and Curves in Space.

【2】学习目标：

理解：Rectangular Coordinate System in Space; Concept of vectors and their representation; Common quadratic surface equations and their graphs.

掌握：Vector Operations; Methods for finding equations of planes and lines; Calculating angles between planes and planes, planes and lines, and lines and lines; Solving problems related to parallelism and perpendicularity of lines and planes; Methods for finding distances from a point to a line and from a point to a plane; Equations of simple cylindrical surfaces and rotational surfaces.

【3】重点内容：

(1) Vector Operations.

(2) Methods for finding equations of planes and lines.

(3) Common quadratic surface equations and their graphs.

【4】难点内容：

(1) Vector Operations.

(2) Methods for finding equations of planes and lines.

(3) Common quadratic surface equations and their graphs.

第 4 章：Multivariate Calculus（支撑教学目标 1-4、2-2、3-3、3-4）

【1】知识点：

(1) Limits and Continuity of Multivariate Functions

(2) Partial Derivatives and Total Differentials

(3) Differentiation Rules for Multivariate Functions

(4) Geometric Applications of Multivariate Calculus

(5) Extreme of Multivariate Functions

【2】学习目标：

理解：Geometric interpretation of functions of two variables; Concepts of partial derivatives and total differentials for multivariate functions; Concepts of directional derivatives and gradients; Concepts of extreme and conditional extreme for multivariate functions.

掌握：Methods for Calculating Partial Derivatives; Methods for calculating total differentials; Finding the tangent line to a space curve and the tangent plane to a surface; Methods for calculating directional derivatives and gradients; Finding the extreme and conditional extreme of functions of two variables; Finding the maximum and minimum values of multivariate functions.

【3】重点内容：

(1) Concepts of partial derivatives and total differentials for multivariate functions.

(2) Concepts of directional derivatives and gradients.

(3) Methods for Calculating Partial Derivatives.

(4) Finding the maximum and minimum values of functions of two variables.

【4】难点内容：

(1) Concepts of partial derivatives and total differentials for multivariate functions.

(2) Methods for Calculating Partial Derivatives.

(3) Finding the maximum and minimum values of multivariate functions.

第 5 章：Multiple Integrals（支撑教学目标 1-5、2-1、3-1、3-4）

【1】知识点：

(1) Concepts and Properties of Multiple Integrals.

(2) Calculation for Double Integrals.

(3) Calculation for Triple Integrals.

【2】学习目标：

理解：Concepts of Double Integrals and Triple Integrals

掌握：Calculation for Double Integrals (Rectangular Coordinates, Polar Coordinates); Calculation for Triple Integrals (Rectangular Coordinates, Cylindrical Coordinates, Spherical Coordinates); Area of plane regions and volume of solids.

【3】重点内容：

(1) Calculation for Double Integrals (Rectangular Coordinates, Polar Coordinates).

(2) Calculation for Triple Integrals (Rectangular Coordinates, Cylindrical Coordinates, Spherical Coordinates).

【4】难点内容：

(1) Calculation for Double Integrals (Rectangular Coordinates, Polar Coordinates).

(2) Calculation for Triple Integrals (Rectangular Coordinates, Cylindrical Coordinates, Spherical Coordinates).

第 6 章：Line Integrals and Surface Integrals（支撑教学目标 1-6、2-1、2-2、3-1）

【1】知识点：

(1) Line integrals with respect to arc length.

(2) Line integrals with respect to coordinates.

(3) Green's formula and its applications.

(4) Surface integrals with respect to area.

(5) Surface integrals with respect to coordinates

(6) Gauss's formula and its applications.

(7) Stokes' formula and its applications.

【2】学习目标：

理解：Concepts of two types of line integrals; Concepts of two types of surface integrals.

掌握：Calculation of two types of line integrals; Calculation of two types of surface integrals; Green's formula and its applications; Gauss's formula and its applications; Stokes' formula and its applications.

【3】重点内容：

(1) Calculation of two types of line integrals.

(2) Green’s formula and path Independence.

(3) Calculation of two types of surface integrals.

(4) Gauss’s formula.

【4】难点内容：

(1) Green's formula and path Independence.

(2) Calculation of surface integrals with respect to coordinate.

第 7 章：Definitions of Statistics and its properties（支撑教学目标 1-7、2-4、3-1、3-2）

【1】知识点：

(1) Overview and descriptive statistics.

(2) Sample spaces and events, axioms, interpretations, and properties of probability.

(3) Counting techniques.

(4) Conditional probability, independence.

【2】学习目标：

理解：Basic concepts in statistics; Properties of probability and counting techniques.

掌握：Law of total probability; Bayes' theorem; Independence.

【3】重点内容：

(1) Properties of probability.

(2) Counting techniques.

【4】难点内容：

(1) Law of total probability.

(2) Bayes' theorem.

(3) Independence.

第 8 章：Random variable and probability distribution（支撑教学目标 1-7、2-4、3-2、3-3）

【1】知识点：

(1) Random variables, probability distributions for discrete random variables.

(2) Binomial probability distribution and the Poisson probability distribution.

(3) Probability density functions, cumulative distribution functions .

(4) The normal distribution and the exponential distribution.

(5) Jointly distributed random variables.

(6) Expected values, variance, co-variance and correlation coefficient.

【2】学习目标：

理解：Probability distributions and expected values for discrete random variables and continuous random variables; Probability density functions and cumulative distribution functions of continuous random variables.

掌握：Several special distributions of discrete random variables and continuous random variables; The joint probability mass function，the joint probability density function and the marginal probability density functions; The properties of expected values, variance, co-variance and correlation coefficient.

【3】重点内容：

(1) Probability density functions and cumulative distribution functions of continuous random variables.

(2) Several special distributions of discrete random variables and continuous random variables

【4】难点内容：

(1) The joint probability mass function.

(2) The joint probability density function .

(3) The marginal probability density functions.

(4) The properties of expected values, variance ,co-variance and correlation coefficient.

第 9 章：Statistics and estimation method（支撑教学目标 1-8、2-5、3-3、3-4）

【1】知识点：

(1) Statistics and their distributions, the distribution of the sample mean, and the distribution of a linear combination.

(2) Point estimation.

(3) Methods of point estimation.

(4) Tests of hypotheses based on a single sample.

(5) Simple linear regression and correlation.

【2】学习目标：

理解：Distribution of the sample mean, and the distribution of a linear combination; The central Limit theorem, the cases of a normal population distribution, Some general concepts of point estimation, the method of moments and maximum likelihood estimation.

掌握：Z tests and T tests for the mean of a single normal population; The simple linear regression model, principle of least squares.

【3】重点内容：

(1) The method of moments and maximum likelihood estimation.

(2) Z tests and T tests for the mean of a single normal population.

(3) The simple linear regression model.

【4】难点内容：

(1) Z tests and T tests for the mean of a single normal population.

(2) The simple linear regression model, principle of least squares

五、教学安排与学时分配

This course is primarily based on classroom teaching, supplemented by discussions, case studies, and other forms. The classroom teaching focuses on the basic concepts, theories, and methods of the course. Centered on the fundamental task of fostering virtue through education, the course aims to cultivate well-rounded socialist builders and successors who excel in moral, intellectual, physical, aesthetic, and labor development. The course takes the concepts and theories of discrete structures as its main thread and uses the modeling and application of discrete problems as its framework. It fully utilizes offline classroom, online teaching resources, and ideological and political education cases to conduct teaching activities. It aims to impart theoretical knowledge, guide values, deepen patriotism, and strengthen the concept of a strong nation. The course aims to solidify basic knowledge, enhance practical skills and innovative spirit, and establish correct views on life, the world, and values. The allocation of class hours for face-to-face instruction is shown in Table 2.

表 2 学时分配表

讲 课 内 容		学时				
		讲课	实验	上机	设计	课外
第 1 章	Differential Equations	10	0	0	0	0
第 2 章	Series	12	0	0	0	0
第 3 章	Analytic Geometry	6	0	0	0	0
第 4 章	Multivariate Calculus	14	0	0	0	0
第 5 章	Multiple Integrals	12	0	0	0	0
第 6 章	Line Integrals and Surface Integrals	12	0	0	0	0
第 7 章	Definitions of Statistics and its properties	8	0	0	0	0
第 8 章	Random variable and probability distribution	10	0	0	0	0

第 9 章	Statistics and estimation method	12	0	0	0	0
小计		96	0	0	0	0
总计	96					

六、教学方法

1. Teach fundamental principles, link theory with practice, emphasize the basic logic and applications of advanced mathematics, and foster students' innovative abilities.

2. Utilize a combination of multimedia presentations and traditional teaching methods to enliven the classroom.

3. Combine theoretical instruction with discussions, and use the Rain Classroom online platform to test knowledge to motivate students' enthusiasm for learning and developing their self-study skills, teamwork abilities, and problem-solving capabilities.

七、成绩评定

This course follows the concept of continuous monitoring for assessment. The evaluation consists of three parts: attendance, assignments, classroom tests, and the final exam. The specific requirements and grading methods are as follows:

1. Attendance: Attendance accounts for 10% of the total grade. Students are required to participate and sign in for all sessions of the course. Students who miss 33% or more of the classes will lose the eligibility to take the final exam for this course.

2. Assignment: Assignments account for 20% of the total grade. Late submissions or assignments found to be plagiarized (identical) will receive a score of zero for that assignment.

3. Mid-term Exam: The mid-term exam accounts for 20% of the total grade.

4. Final Exam: The final exam accounts for 50% of the total grade.

八、评价及持续改进

1、教学大纲

考核周期：4 年，修订周期：4 年。

改进措施：课程负责人组织课程团队所有教师讨论后提出改进意见，经教研室主任审核后由教学院长批准。

1. Teaching Syllabus

Assessment Period: 4 years; Revision Period: 4 years

Improvement Measures: The course leader organizes a discussion with all course teachers to propose improvement suggestions, which are reviewed by the department head and approved by the dean of the faculty.

2、成绩评定考核

考核周期：1 学年，评价依据：学生最终成绩综合分析。

改进措施：根据学生最终成绩的分布，进行相应的内容调整和优化，并改进教学方法。

2. Performance Evaluation and Assessment

Assessment Period: 1 academic year

Evaluation Basis: Comprehensive analysis of students' final grades

Improvement Measures: Adjust and optimize the content and improve teaching methods based on the distribution of students' final grades.

撰写：　　郭静梅 王翠萍

审核：　　薛昌涛

批准：

日期：　　2023.07.05