

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1. 课程名称 Course Title	运筹学 Operations Research				
2. 授课院系 Originating Department	数学系 Department of Mathematics				
3. 课程编号 Course Code	MA210				
4. 课程学分 Credit Value	3				
5. 课程类别 Course Type	专业选修课 Major Elective Courses				
6. 授课学期 Semester	春季 Spring				
7. 授课语言 Teaching Language	英文 English				
8. 授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	张进 数学系 慧园 3 栋 509 zhangj9@sustc.edu.cn 0755-88015915 Jin Zhang, Department of Mathematics, Block 3 Room 509, Wisdom Valley. zhangj9@sustc.edu.cn 0755-88015915				
9. 实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	(请保留相应选项 Please only keep the relevant information)				
10. 选课人数限额(可不填) Maximum Enrolment (Optional)					
11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
学时数 Credit Hours	46		N/A		46

<p>12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements</p>	<p>数学分析 III 或数学分析精讲 Mathematical Analysis III or Real Analysis</p>
<p>13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite</p>	<p>是数学系和金融数学系金融数学及金融工程等课程的先修课程，同时也是其他工程学科多门专业课的先修课程。 It is a pre-requisite course for courses in finance mathematics and financial engineering in the Department of Mathematics and Financial Mathematics. It is also a pre-requisite course for many professional courses in other engineering disciplines.</p>
<p>14. 其它要求修读本课程的学系 Cross-listing Dept.</p>	

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

运筹学主要向学生系统地讲授线性规划、无约束优化、约束优化、多目标优化、整数规划等运筹学建模和基本优化方法，同时包括运筹学模型的模型条件、结构特点、基本方法步骤及应用范围等；使学生认识到运筹学模型和优化应用在实践中重要性，领会其基本思想和分析、解决问题的思路。

Operational research mainly teaches the students the systematical methods of operational research and basic optimization, including linear programming, unconstrained optimization, constrained optimization, multi-objective programming and integer programming. It also contains some operational research models, such as model conditions, structure features, basic steps, application scope, etc. Operational research makes the students realize the importance of the operation research modeling and optimization applications in practice, understand the thought of the basic ideas and analysis when solving problems

16. **预达学习成果 Learning Outcomes**

通过对本课程的学习，学生可以达到以下基本要求：

- 1.掌握线性规划、约束优化、多目标优化、动态规划、整数规划等运筹学模型；
- 2.通过对具体方法与模型的学习，认识运筹学在经营管理决策中作为提高决策水平的方法和作用；
- 3.了解运筹学模型以及主要的相关优化方法；
- 4.领会运筹学在分析与解决实际问题过程中的基本思想和的基本思路，并进行以实际应用为导向的训练。

After completing this course, students should meet the following basic requirements:

1. Master the operational research model, such as linear programming, constrained programming, multi-objective programming, dynamic programming and integer programming;
2. Recognize the operational research's effects that was used as the methods and tools to improve the level of decision-making in the management decisions, throughout the specific methods and models of learning;
3. Understand the operational research models and master the related optimization methods;
4. Comprehend the basic idea and thought of operational research that are used in analyzing and solving the actual problems, carry on the training of the practical-oriented application.

17. **课程内容及教学日历**（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

1. 优化概论（4学时）

Introduction to optimization (4 hours)

2. 线性规划和单纯形法（5学时）

Linear programming and the Simplex Method (5 hours)

3. 无约束优化方法（7学时）

Unconstrained optimization methods (7 hours)

4. 非线性优化基础：（6学时）

Basics of nonlinear optimization: (6 hours)

5. 约束优化方法（8学时）

Constrained optimization methods (8 hours)

6. 多目标优化（4学时）

Multi-objective programming (4 hours)

7. 整数规划（4学时）

Integer programming (4 hours)

8. 动态规划（4学时）

Dynamic programming (4 hours)

9. 专题一：运筹学与数据科学（2学时）

Special topic I: operational research and data science (2 hours)

10. 专题二：运筹学与博弈论（2学时）

Special topic II: operational research and game theory (2 hours)

每周进度 weekly schedule:

第1周：优化体系、类型以及全局最优解和局部最优解（4学时）

Week 1: optimization terms, types, and global vs local solutions (4 hours).

第2周：线性规划问题及数学模型（2学时）

Week 2: linear programming (2 hours).

第3周：单纯形法原理及计算步骤、极值点、基本可行解,等（3学时）。凸函数与凸集合（1学时）

Week 3: concepts of extreme point, basic feasible solution, etc (3 hours). Convex function and convex set (1 hour).

第 4 周：梯度下降算法（2 学时）

Week 4: Gradient descent method (2 hours).

第 5 周：牛顿型法（2 学时）和拟牛顿法（2 学时）。

Week 5: Newton method (2 hours) and quasi-Newton methods (2hours).

第 6 周：约束优化问题的必要性条件（2 学时）

Week 6: necessary optimality conditions of constrained optimization (2 hours).

第 7 周：约束优化问题的充分性条件（2 学时）与凸优化的 KKT 条件（2 学时）。

Week 7: sufficient optimality conditions of constrained optimization (2 hours) and KKT conditions for convex optimization (2 hours).

第 8 周：罚函数法(2 学时)。

Week 8: penalty function method (2 hours).

第 9 周：障碍函数法（2 学时）与梯度投影法（2 学时）。

Week 9: barrier function method (2 hours) and gradient projection method (2 hours).

第 10 周：增广拉格朗日法（2 学时）。

Week 10: Augmented Lagrangian method (2 hours).

第 11 周：多目标优化的模型介绍（1 学时）、求解方法和应用（3 学时）。

Week 11: introduction to multi-objective programming (1hour), solution schemes and applications (3 hours).

第 12 周：专题一：运筹学与数据科学（2 学时）

Week 12: special topic I: operational research and data science (2 hours)

第 13 周：整数规划模型的介绍（1 学时）、分支定界法（2 学时）、0-1 规划（1 学时）

Week 13: introduction to integer programming (1 hour), branch-and-bound method (2hours), binary programming (1 hour)

第 14 周：专题二：运筹学与博弈论（2 学时）

Week 14:Special topic II: operational research and game theory (2 hours)

第 15 周：动态规划模型介绍（1 学时）、求解方法和应用（3 学时）。

Week 15: introduction to dynamic programming (1hour), solution schemes and applications (3hours).

18. 教材及其它参考资料 Textbook and Supplementary Readings

Supplementary Readings:

- 1) An Introduction to Optimization, 4th Edition, by Chong and Zak
- 2) Undergraduate nonlinear continuous optimization, lecture notes, by James V Burke, University of Washington
- 3) An easy path to convex analysis and applications, by Mordukhovich and Nam

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance				
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		20%		
期中考试 Mid-Term Test		20%		
期末考试 Final Exam	2 小时 2 hours	60%		
期末报告 Final Presentation				
其它 (可根据需要 改写以上评估方 式) Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading
 B. 二级记分制 (通过/不通过) Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
 This Course has been approved by the following person or committee of authority