课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	MAT7089 最优化理论与方法 Optimization Theory and Method
2.	**课程性质** **Compulsory/Elective**	专业选修课　　Major Elective Courses
3.	**课程学分/学时** **Course Credit/Hours**	3 学分/44 学时　　3 credits/44 hours
4.	**授课语言** **Teaching Language**	英文　　English
5.	**授课教师** **Instructor(s)**	张进　数学系　　Jin Zhang, Department of Mathematics, 慧园 3 栋 509　　Block 3 Room 509, Wisdom Valley. zhangj9@sustc.edu.cn　　zhangj9@sustc.edu.cn 0755-88015915　　0755-88015915
6.	**是否面向本科生开放** **Open to undergraduates or not**	否　　no
7.	**先修要求** **Pre-requisites**	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 高等数学下（MA102b）（或数学分析 II（MA102a））， 线性代数 II（MA104b），概率论（或概率论与数理统计）， 凸优化算法 (课程代码待定) Calculus (MA102b) (or Mathematical Analysis II (MA102a)), Linear Algebra (MA104b), Probability theory (or probability theory and mathematical statistics) Algorithms for convex optimization
8.	**教学目标** **Course Objectives**	
	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 本课程是为对凸分析和非光滑分析和优化理论有浓厚兴趣的的学生设置的。凸分析和非光滑分析不仅对于优化理论有着重要影响，其本身也有着十分丰富且值得研究的内容。本课程从有限维空间设定下的凸理论出发引入非光滑分析及其相关概念。本课程的目标是让学生全面了解凸分析领域的现代研究方法，并为学生进一步学习非光滑分析、变分分析及其应用拓展打下基础。 This course is for students strongly interested in convex analysis and nonsmooth analysis, which not only have an important influence on optimization theory, but also have a lot of content of themselves worth studying. We will introduce nonsmooth analysis and related concepts from convex theory under the setting of finite dimensional space. The goal of this course is to make students have a comprehensive understanding of modern research methods in convex analysis, and to lay a foundation for students to further study non-smooth analysis, variational analysis, and their applications.	
9.	**教学方法** **Teaching Methods**	
	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 讲授与习题　Lectures，tutorials	
10.	**教学内容**	

Course Contents
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Section 1 凸集和凸函数的基本性质 Convex Sets and Functions	预备知识的介绍，数学分析实数理论，线性空间理论，几何知识初步 Preliminaries, Basic knowledge of real number theory, linear space and geometry
Section 2 凸性 Convexity	凸集的定义与性质、凸函数的定义与性质、保凸运算、凸集的相对内部、凸分离、距离函数 Convex sets and convex functions, Operations that preserve convexity, Relative interiors of convex sets, Convex separation, The distance function
Section 3 次微分的运算 Subdifferential Calculus	集合收敛、法锥与切锥、集值映射、映射的 coderivative 算子、次梯度及其基本运算法则、最优值函数与支撑函数的次梯度、Fenchel 共轭、对偶理论 Convex separation, Normals and tangents sets, Set-valued mappings and the coderivative operator, Subgradients and basic calculus rules, Subgradients of optimal value functions and support functions, Fenchel conjugates, Dualization
Section 4 一些基于凸性的著名结果与变分性质简介 Remarkable Consequences of Convexity and introduction to variational principle	可微性的刻画、Carathéodory 定理和 Farkas 引理、Radon 定理和 Helly 定理、中值定理、极小时间函数的 Minkowski 度规、极小时间函数的次梯度、极值原理、变分原理 Characterizations of differentiability, Carathéodory theorem and Farkas theorem , Radon theorem and Helly theorem, Mean value theorem, Minimal time function and Minikowski gauge, Subgradients of minimal time functions, Extremal principle, Variational principles
Section 5 （凸分析）在最优化和选址问题中的应用、非光滑优化初步 Applications to Optimization and Location Problems, Nondifferentiable Optimization	优化问题入门、下半连续性和极小值点的存在性、最优性条件、Fermat-Torricelli 问题、广义 Sylvester 问题简介、广义 KKT 系统 Subgradients of minimal time functions, Introduction to optimization, Lower semicontinuity and existence of minimizers Optimality conditions, The Fermat-Torricelli problem, A generalized Sylvester problem, Generalized KKT form.

11. 课程考核
Course Assessment

（①考核形式 Form of examination；②.分数构成 grading policy；③如面向本科生开放，请注明区分内容。If the course is open to undergraduates, please indicate the difference.）
小测验、平时作业（30%），期中考试（20%），期末考试（50%）
Quiz, Assignments (30%), Mid-Term Test (20%), Final Exam (50%)

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

Textbooks

1、B Mordukhovich and Nam, An Easy Path to Convex Analysis and Applications, 2015

Supplementary Readings:

1、 R. T. Rockafellar, Convex Analysis, 1970

2、 F. H. Clarke, Yu. S. Ledyaev, R. J. Stern and R. R. Wolenski, Nonsmooth Analysis and Control Theory, 1998