南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

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	抽象代数 Abstract Algebra
2.	授课院系 Originating Department	数学系 Department of Mathematics
3.	课程编号 Course Code	MA214
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	中英双语 English & Chinese
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）	胡勇，数学系 慧园 3 栋 409 huy@sustc.edu.cn 0755-8801-5910 Yong Hu, Department of Mathematics Block 3, Room 409, Wisdom Valley huy@sustc.edu.cn 0755-8801-5910
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced
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	48				48

12.	先修课程、其它学习要求 **Pre-requisites or Other Academic Requirements**	线性代数 II (Ma104b)、初等数论 (MA209-16) Linear Algebra II (Ma104b)、Elementary Number Theory (MA209-16)
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	后续课程主要包括：群表示论、代数（研究生）、拓扑学 Main subsequent courses: Group representation theory, Algebra (Graduate), Topology
14.	其它要求修读本课程的学系 **Cross-listing Dept.**	

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

本课程教学内容假定学生具有一定的初等数论知识，在此基础上从抽象代数的基本概念讲起，覆盖群论和环论中最核心的内容。教学目标是使学生知识能够理解抽象代数中的基本概念、具体实例和应用，掌握抽象代数的思维方法。本课程将为后继课程提供所需的代数知识及抽象思维能力的训练。

The course assumes basic knowledge of number theory as prerequisites, begins with fundamental concepts of abstract algebra and covers most important topics in the core of group theory and ring theory. The objectives include familiarizing students with fundamental contents of abstract algebra, having concrete examples and applications well understood, and introducing students to get used to methods of thinking and analyzing in abstract algebra. The course will provide necessary background knowledge of algebra and adequate training of abstract thinking for the study of subsequent courses.

16. **预达学习成果 Learning Outcomes**

学生通过本课程的学习能够理解抽象代数的基本概念，能够结合实例和应用理解群论、环论中最重要的定理。包括熟悉掌握：群论的基本知识、有限生成 Abel 群的结构定理、对称群和二面体群等重要的非交换群、同态基本定理、群作用、以及其他分析有限群结构的主要工具和方法；环论方面能够深刻理解中国剩余定理、多项式环等整环中的因式分解理论、以及与有限域和数域相关的一些应用。

An adequate training through this course should help the students to understand fundamental concepts of abstract algebra and connect concrete examples and applications to theory, thus leading to a good comprehension of the most important theorems in group theory and ring theory. Students are expected to well understand at least the following material: basics of group theory, structure theorem of finitely generated abelian groups, symmetric groups and dihedral groups as most important examples of non-commutative groups, fundamental theorems of group homomorphisms, group actions, as well as other useful tools and methods in the analysis of structure of finite groups; ring theoretic facts like the Chinese remainder theorem, polynomial rings, divisibility theory in various interesting domains, and applications with special regard to finite fields and number fields.

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.)

第0章 初见 (4 学时)

§ 1 当代数姗姗走来

1.1 何为抽象代数

1.2 集合与映射

1.3 二元运算和代数结构

§ 2 群从何处来

2.1 整数及其同余类

2.2 矩阵和置换

2.3 对称

2.4 更神奇的例子

第一章 群论导引 (24 学时)

§ 1 群论若干基本定义

1.1 子群和群同态

1.2 陪集和 Lagrange 定理

1.3 正规子群

1.4 群的直积和直和

§ 2 循环群和有限生成阿贝尔群

2.1 群元素的阶、生成元

2.2 循环群的子群

2.3 有限生成阿贝尔群

§ 3 置换及对称群

3.1 对称群和轮换

3.2 轮换分解

3.3 交错群

§ 4 对称和二面体群

1.1 平面的等距变换

1.2 二面体群和平面图形的对称

§ 5 群同态基本定理

2.1 等价关系和商群

2.2 群同态相关的同构定理

§ 6 群作用和 Sylow 定理

3.1 群作用的基本概念

3.2 关于 p-群的应用

3.3 Sylow 定理

第二章 环论基础 (16 学时)

§ 1 基本定义和性质

1.1 环的定义和例子

1.2 整环和域

1.3 整环的分式域

§ 2 理想与环同态

2.1 理想及商环

2.2 环同态

2.3 中国剩余定理

2.4 极大理想和素理想

§ 3 多项式环

3.1 定义和基本性质

3.2 多项式的欧几里得除法

3.3 域上的多项式

§ 4 整环内的整除性

4.1 素元和不可约元

4.2 UFD 和 PID

4.3 欧几里得环

4.4 UFD 上的多项式

4.5 不可约性判别法

第三章 域和域扩张 (4 学时)

§ 1 域扩张的基本理论

1.1 单扩张和代数扩张

1.2 尺规作图

§ 2 有限域和分圆域

2.1 有限域

2.2 分圆域

Chapter 0: First glimpse (4h)

§ 1 When Algebra comes stately

1.1 What is Abstract Algebra

1.2 Sets and maps

1.3 Binary operations and algebraic structures

§ 2 Where do groups come from

2.1 Integers and their congruence classes

2.2 Matrices and permutations

2.3 Symmetries

2.4 More surprising examples

Chapter 1: Introduction to groups (24h)

§ 1 Basic definitions in group theory

1.1 Subgroups and homomorphisms

1.2 Cosets and Lagrange's theorem

1.3 Normal subgroups

1.4 Direct products and direct sums

§ 2 Cyclic groups and finitely generated abelian groups

2.1 Orders of elements, generators

2.2 Subgroups of cyclic groups

2.3 Finitely generated abelian groups

§ 3 Permutations and symmetric groups

3.1 Symmetric groups and cycles

3.2 Cycle decomposition

3.3 Alternating groups

§ 4 Symmetries and dihedral groups

4.1 Isometries of the plane

4.2 Dihedral groups and symmetry of plane figures

§ 5 Fundamental theorems of group homomorphisms

5.1 Equivalence relations and quotient groups

5.2 Isomorphism theorems for group homomorphisms

§ 6 Group actions and Sylow's theorems

6.1 Basic notions of group actions

6.2 Applications to p-groups

6.3 Sylow's theorems

Chapter 2: Basics of ring theory (16h)

§ 1 Basic definitions and properties

1.1 Definition and examples of rings

1.2 Domains and fields

1.3 Fraction field of a domain

§ 2 Ideals and homomorphisms

2.1 Ideals and quotient rings

2.2 Ring homomorphisms

2.3 Chinese remainder theorem

2.4 Maximal ideals and prime ideals

§ 3 Polynomial rings

3.1 Definitions and basic properties

3.2 Euclidean division for polynomials

3.3 Polynomials over a field

§ 4 Divisibility in integral domains

4.1 Prime elements and irreducible elements

4.2 UFD and PID

4.3 Euclidean domains

4.4 Polynomials over a UFD

4.5 Irreducibility criteria

Chapter 3: Fields and their extensions (4h)

§ 1 Basic theory of field extensions

1.1 Simple extensions and algebraic extensions

1.2 Ruler and compass constructions

§ 2 Finite fields and cyclotomic fields

2.1 Finite fields

2.2 Cyclotomic fields

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

教材 Textbook:

David S. Dummit and Richard M. Foote, Abstract Algebra (Third Edition), John Wiley & Sons, Inc, 2004. ISBN: 978-0-471-43334-7

辅助参考书 Supplementary readings

Joseph Rotman, A First course in abstract algebra, (Third edition), Pearson; 2005. ISBN-13: 978-0-131-86267-8

聂灵沼、丁石孙 著,《代数学引论》第二版, 高等教育出版社, 2000.

冯克勤、李尚志、章璞 著,《近世代数引论》第 3 版, 中国科学技术大学出版社, 2009.

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		10		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		20		
期中考试 Mid-Term Test		35		
期末考试 Final Exam		35		
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