

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	结构化学 Structural Chemistry
2.	授课院系 Originating Department	化学系 Department of Chemistry
3.	课程编号 Course Code	CH340
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业基础课 Major Foundational Courses
6.	授课学期 Semester	春季 Spring
7.	授课语言 Teaching Language	中文 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)	杨烽助理教授，化学系 Dr. Feng Yang, Assistant Professor, Department of Chemistry Email: yangf3@sustech.edu.cn
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	
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			复习、考试 (2周) Revision & Exam (2 weeks)	48
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	物理化学 II (CH302)				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite					
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

本课程重点讲述原子、分子、材料结构基础，主要包括群论、化学键、配位场等基础理论。所涉及的结构涉及分子、化合物、晶体材料等。通过本课程的讲授使学生对物质结构有一个全面的了解，使学生充分熟悉物质的结构关联的化学性质。

This course focuses on the fundamentals of atomic, molecular, and material structures, including basic theories such as group theory, chemical bonds, and coordination fields. The structures involved involve molecules, compounds, crystalline materials, etc. Through the teaching of this course, students will have a comprehensive understanding of the structure of matter, so that students are fully familiar with the chemical properties related to the structure of matter.

16. 预达学习成果 Learning Outcomes

本课程将使学生全面理解物质的结构，提高学生理解物质结构与性质等科学问题的能力；提高学生对物质结构原理、性质的理解；培养学生的创新意识和创新能力，为学生今后从事化学、材料、能源、生命科学、环境等相关领域的科学研究和应用工作打下坚实的基础。

另外，在《结构化学》课程中设置 4 次小组讨论课，由学生小组主讲，提高学生自主学习能力，训练获取、分析、提炼、关联和整合信息能力，能够在未知的领域提出问题，并拥有跨学科解决问题的能力，初步具备从事科学研究的能力。

This course will enable students to fully understand the structure of matter, improve students' ability to understand scientific issues such as the structure and properties of matter; improve students' understanding of the principles and properties of matter structure; Lay a solid foundation for scientific research and applied work in related fields such as materials, energy, life sciences, and environment.

In addition, a group discussion class is set up in the "Structural Chemistry" course to improve students' autonomous learning ability, train the ability to acquire, analyse, refine, correlate and integrate information, be able to ask questions in unknown areas, and have the ability to solve problems across disciplines, Preliminary ability to engage in scientific research.

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. 量子理论与原子结构 4 学时

- 1.1 微观粒子的运动特征
- 1.2 量子数的物理意义
- 1.3 波函数和电子云的图形
- 1.4 多电子原子的结构
- 1.5 原子光谱

2. 共价键和双原子分子的结构和性质 6 学时

- 2.1 氢分子离子的结构和共价键的本质
- 2.2 分子轨道理论和双原子分子的结构
- 2.3 分子光谱
- 2.4 光电子能谱

小组讨论 1 氢原子光谱

3. 分子的对称性 4 学时

- 3.1 对称操作和对称元素
- 3.2 对称操作群及对称元素的组合
- 3.3 分子的点群
- 3.4 分子的对称性和分子的极性
- 3.5 分子的对称性和分子的旋光性
- 3.6 群的表示

4. 多原子分子中的化学键 6 学时

- 4.1 杂化轨道理论
- 4.2 离域分子轨道理论
- 4.3 休克尔分子轨道法
- 4.4 离域 π 键和共轭效应

5. 配位化合物的结构和性质 4 学时

- 5.1 配位场理论
- 5.2 σ - π 配键与有关配合物的结构和性质
- 5.3 金属-金属键

小组讨论 2 氢键介绍

期中考试

6. 晶体的点阵结构和晶体的性质 6 学时

- 6.1 晶体结构的周期性和点阵
- 6.2 晶体结构的对称性
- 6.3 点阵的标记和点阵平面间距
- 6.4 空间群和晶体结构的表达
- 6.5 晶体的衍射

小组讨论 3 准晶

7. 金属的结构和性质 4 学时

- 7.1 球的密堆积
- 7.2 金属单质的性质

8. 离子晶体的结构和性质 4 学时

- 8.1 离子晶体的若干简单结构型式
- 8.2 离子键和点阵能
- 8.3 离子半径
- 8.4 离子化合物的结晶化学规律

9. 晶体的缺陷 4 学时

- 9.1 缺陷的分类
- 9.2 点缺陷
- 9.3 位错



9.4 位错的运动

9.5 界面

10. 电子显微学在晶体结构解析中的应用 4 学时

10.1 高分辨电子显微镜

10.2 电子衍射

小组讨论 4 X 射线衍射与中子衍射

复习习题课 2 学时

期末考试

1. Quantum theory and atomic structure 4 class hour

1.1 The motion characteristics of microscopic particles

1.2 Physical significance of quantum numbers

1.3 Graphs of wave functions and electron clouds

1.4 Structure of Multi-Electron Atoms

1.5 Atomic spectrum

2. Structure and properties of covalent bonds and diatomic molecules 6 class hour

2.1 The structure of the hydrogen molecular ion and the nature of covalent bonding

2.2 Molecular orbital theory and the structure of diatomic molecules

2.3 Molecular spectroscopy

2.4 Photoelectron spectroscopy

Group Discussion 1: Hydrogen Atom Spectroscopy

3. Molecular symmetry 4 class hour

3.1 Symmetry operations and symmetry elements

3.2 Symmetry operation groups and combinations of symmetry elements

3.3 Point Groups of Molecules

3.4 Symmetry of molecules and polarity of molecules

3.5 Symmetry of Molecules and Spin of Molecules

3.6 Representation of groups

4. Chemical bonding in polyatomic molecules 6 class hour

4.1 Hybridized Orbital Theory

4.2 Off-domain molecular orbital theory

4.3 The Shocker molecular orbital method

4.4 Off-domain π -bonding and conjugation effects

5. Structure and properties of coordination compounds 4 class hour

5.1 Coordination Field Theory

5.2 Structure and properties of σ - π coordination bonds and related complexes

5.3 Metal-metal bonding

Group Discussion 2: Introduction to Hydrogen Bonds

Mid-term exam

6. Lattice structure and properties of crystals 6 class hour

6.1 Periodicity and lattice of crystal structure

6.2 Symmetry of Crystal Structures

6.3 Marking of dot matrix and dot plane spacing

6.4 Space Groups and Representation of Crystal Structures

6.5 Diffraction of Crystals

Group discussion 3: Quasicrystals

7. Structure and properties of metals 4 class hour

7.1 Dense packing of balls

7.2 Properties of metal monomers

8. Structure and properties of ionic crystals 4 class hour

8.1 Some simple structural forms of ionic crystals

8.2 Ionic bonding and dot energy

<p>8.3 Ionic radii</p> <p>8.4 Laws of crystallization chemistry of ionic compounds</p> <p>9. Defects in crystals 4 class hour</p> <p>9.1 Classification of defects</p> <p>9.2 Point defects</p> <p>9.3 Dislocations</p> <p>9.4 Movement of dislocations</p> <p>9.5 Interfaces</p> <p>10. Application of electron microscopy in crystal structure analysis 4 class hour</p> <p>10.1 High-resolution electron microscope</p> <p>10.2 Electron diffraction</p> <p>Group Discussion 4: X-ray Diffraction and Neutron Diffraction</p> <p>Review exercises 2 class hour</p> <p>Final exam</p>

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

<p>Required: 北京大学, 结构化学基础 (第5版), 周公度、段连运编著, 北京大学出版社, 2017年</p> <p>Recommended: Physical Chemistry, A Molecular Approach, Donald A. McQuarrie, John D. Simon, University Science Books, Sausalito, California, 1997</p>
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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		5		
小组讨论 Group Discussion		10		
小测验 Quiz		10		
课程项目 Projects				
平时作业 Assignments		10		
期中考试 Mid-Term Test		25		
期末考试 Final Exam		40		
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

教学负责人签字：
日期：

