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**	**无机化学 I** **Inorganic Chemistry I**
2.	**授课院系** **Originating Department**	化学系 Department of Chemistry
3.	**课程编号** **Course Code**	CH209
4.	**课程学分 Credit Value**	4
5.	**课程类别** **Course Type**	专业基础课 Major Foundational Courses
6.	**授课学期** **Semester**	秋季 Fall
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）**	陆为，教授，化学系，luw@sustech.edu.cn Prof. Wei Lu, Department of Chemistry, luw@sustech.edu.cn
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	64				64

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	本课程为化学专业基础课，化学专业必修课，材料、环境等相关专业选修课 This course should be taken by everyone contemplating doing Chemistry in the following years. It should however also be suitable for students majoring in Materials Sciences and Environmental Sciences.
14.	其它要求修读本课程的学系 Cross-listing Dept.	环境科学与工程、材料科学与工程、生物医学工程、所有对化学感兴趣的孩子

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

无机化学讲解元素周期表里各个元素化合物的结构、成键规律、性质与反应模式。

无机化学 I 课程是讲解无机和配位化学的基本知识和工具，学习此课程，学生可以掌握以下概念和方法：原子轨道，简单成键理论，分子轨道理论，分子对称性，点群及其在化学中的应用，基本酸碱理论，固体结构化学导论，主族元素化学导论，配位化合物的结构、成键理论和光谱。

Inorganic chemistry deals with the structures, bonding interactions, properties and reactions of all of the elements in the periodic table.

The course of Inorganic Chemistry I aims to provide a comprehensive and contemporary introduction to the diverse and fascinating discipline of inorganic and coordination chemistry by providing the topics on atomic orbitals, simple bonding theory and molecular orbital theory, molecular symmetry, point group and its application in chemistry, basic acid-base theory, introduction to solid-state structures, main group chemistry, and structures, bonding theories, and electronic spectra of coordination complexes.

16. 预达学习成果 Learning Outcomes

这是一个特别设计的课程，学生通过此课程的学习，可以获得无机化学各元素和配位化合物性质的轨道和结构描述方法和基本理解工具。

In this particular part of the Inorganic Chemistry Course, the students should have basic understanding of orbitals, bonding and structural description on basic inorganic and coordination chemistry at the end of this course.

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.)

课程教师是陆为。课程 4 学分，平均每周 4 学时，共 64 学时。讲解重点部分是点群及其在化学中的应用和配位化合物结构与配位场理论。学时分配如下：

1. 无机化学课程简介, 2 学时;

简单介绍无机化学学科的范畴和历史，着眼于无机化学与有机化学的区别和共性。

2. 原子轨道, 2 学时;

讲解原子理论的历史发展及其在元素周期表建立过程中的关键作用。讲解量子数的引入、原子轨道的概念、电子的填充规则，元素的周期性。

3. 简单成键理论, 2 学时;

讲解路易斯电子结构式，共振的概念，电子计数，多重键，价电子对互斥理论，分子极性和氢键、卤键的形成与描述。

4. 分子对称性, 4 学时;

讲解分子对称元素和操作及表示。

5. 点群及简单群论, 6 学时;

引入点群概念和分子对称性的群表示和性质，特征标表的使用及其在分子手性和分子振动光谱指认中的应用。

6. 分子轨道, 8 学时;

讲解从原子轨道线性组合形成分子轨道的原理方法，以及光电子能谱得到的轨道能级实验方法。第一、二周期同和双原子分子的分子轨道表示；以 HF2-, CO, H2O, NH3, BF3 等简单分子为例讲解分子轨道描述成键的方法。

7. 简单酸碱理论, 4 学时;

讲解酸碱理论的历史，Arrhenius、Brønsted–Lowry、Lewis 三种酸碱模型，Lewis 酸碱的分子轨道表示，分子间作用力，软硬酸碱理论。

8. 固体化学导论, 4 学时;

讲解固体化合物的化学式和结构，离子晶体的成键和热力学，分子轨道和能带结构，简单超导概念，晶体的不完美性，典型硅酸盐。

9. 主族化学导论, 4 学时.

概述各主族的主要元素的性质与化学。

10. 配位化合物的结构与异构, 4 学时.

讲解配位化合物的配位数和几何结构关系，异构体术语、类型、手性和实验拆分并表征配位异构体。

11. 配位化合物的成键理论, 8 学时.

讲解配位场理论（从分子轨道出发理解配位化合物的成键），轨道裂分、电子自旋、角动量叠加、杨-泰勒变形等概念和理论。

12. 配位化合物的电子光谱, 8 学时.

讲解配位化合物的电子吸收光谱，引入多电子原子的量子数、光谱跃迁选律、电子态相关图、Tanabe-Sugano 图，电荷转移光谱。

13. 配位化合物的反应与机理, 6 学时.

讲解配位化合物的取代反应，着重配位体离解、交换和再配位等反应路径对反应动力学的影响及其实验证据，引入配位化合物反应的立体化学、反式效应、氧化还原化学和反应性配体等概念。

The core course coordinator is Prof. Wei Lu.

The course consists of 4 credits, which will focus on point groups and its applications in chemistry and ligand field theory of the coordination complexes.

1. Introduction to Inorganic Chemistry, 2 hours;

What Is Inorganic Chemistry, Contrasts with Organic Chemistry, and the history of Inorganic Chemistry.

2. Atomic orbitals, 2 hours;

Historical Development of Atomic Theory, The Periodic Table, Quantum Numbers and Atomic Wave Functions, The Aufbau Principle, Periodic Properties of Atoms.

3. Simple Bonding Theories, 2 hours;

Lewis Electron-Dot Diagrams, Higher Electron Counts, Multiple Bonds, Valence Shell Electron-Pair Repulsion, Molecular Polarity, Hydrogen Bonding, Halogen Bonding.

4. Molecular Symmetry, 4 hours;

Symmetry Elements and Operations

5. Point Groups and Simple Group Theory, 6 hours;

Point Groups, Properties and Representations of Groups, Representations of Point Groups, Character Tables, and Examples and Applications of Symmetry in Chirality and Molecular Vibrations.

6. Molecular Orbitals, 8 hours;

From Atomic Orbitals to Molecular Orbitals, Homonuclear Diatomic Molecules of the First and Second Periods, Photoelectron Spectroscopy, Molecular Orbitals for Larger Molecules, including HF2-, CO, H2O, NH3, BF3.

7. Basic Acid-Base Theory, 4 hours;

History of Acid–Base Models (Arrhenius Concept and Brønsted–Lowry Concept), Lewis Acid–Base Concept and Frontier Orbitals, Intermolecular Forces, Hard and Soft Acids and Bases.

8. Introduction to Solid-State Chemistry, 4 hours;

Formulas and Structures, Thermodynamics of Ionic Crystal Formation, Molecular Orbitals and Band Structure, Superconductivity, Bonding in Ionic Crystals, Imperfections in Solids, Silicates.

9. Introduction to Main Group Chemistry, 4 hours.

General Trends in Main Group Chemistry including elemental properties and compounds of Hydrogen, Group 1: The Alkali Metals, Group 2: The Alkaline Earths, Group 13, Group 14, Group 15, Group 16, Group 17: The Halogens, Group 18: The Noble Gases.

10. Structures and Isomers of Coordination Complexes, 4 hours;

Coordination Numbers and Structures, Nomenclature, Isomers, Chirality, Separation and Identification of Coordination Complexes.

11. Bonding in Coordination Complexes, 8 hours;

Ligand Field Theory (molecular approach for coordination complexes), Orbital Splitting, Electron spin, Angular Overlap, Jahn-Teller Distortion in Coordination Complexes.

12. Electronic Spectra of Coordination Complexes, 8 hours;

Absorption and Light, Quantum Numbers of Multielectron Atoms, Selection Rules, Correlation Diagrams, Tanabe-Sugano Diagrams and Charge-Transfer Spectra of Coordination Complexes.

13. Reactions and Mechanisms of Coordination Complexes, 6 hours.

Substitution Reactions, Kinetic Consequences of Reaction Pathways for Ligand Dissociation, Interchange and Association, Experimental Evidences, Steorochemistry, The Trans Effect, Oxidation-Reduction Reactions.

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

1. L. M. Garey and A. T. Donald, Inorganic Chemistry, Fourth Edition, Pearson Education (原版) [无机化学 第四版 (影印版), 机械工业出版社]

2. P. W. Atkins, T. L. Overton, J. P. Rourke, M. T. Weller, and F. A. Cotton, Advanced Inorganic Chemistry, Fifth Edition 2010, W. H. Freeman and Company New York.

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		15		
课程项目 Projects				
平时作业 Assignments		20		
期中考试 Mid-Term Test				
期末考试 Final Exam		50		
期末报告 Final Presentation				
文献摘要 Digest of Literature		15		

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

化学系教学指导委员会 Teaching Committee of the Chemistry Department