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**	**有机化学 B** **Organic Chemistry B**
2.	**授课院系** **Originating Department**	化学系 Department of Chemistry
3.	**课程编号** **Course Code**	CH106
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 / 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）**	周友运，副教授，化学系，zhouyy@sustech.edu.cn You-Yun Zhou, Associate Professor, Department of Chemistry, zhouyy@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	48	0	0	0	48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	Pre-requisites: 化学原理 B (CH101B)
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	有机化学实验（CH208） Organic Chemistry Laboratory
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 None

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程旨在为学生学习有机化学的基础知识和其对生物学科的重要性。本课程的学习将帮助学生了解和掌握有机化学的基本概念和原理，重要的有机化学反应和机理，有机化合物的结构鉴定和立体化学，简单有机化合物的合成设计和相关的合成反应，一些生物大分子及其组成单元有机小分子的结构、性质与反应性能和相关的有机反应，为未来的学习和科学研究奠定基础。

This course is designed to provide undergraduate students with a fundamental overview of organic chemistry and its importance to biological sciences. This course includes basic concepts and principles in organic chemistry, major classes of reactions, organic reaction mechanisms and pathways, structure determination and stereochemistry of organic compounds, design and synthesis of the targeted organic molecules and asymmetric synthesis, some of the chemistry of biomolecules: carbohydrates, nucleic acids, lipids, amino acids and peptides, and enzymatic reactions.

16. 预达学习成果 Learning Outcomes

预期学习效果：

- 能够理解有机化学的基本概念，并能够有效的运用其中的专业名词；
- 能够理解分子的三维立体结构的性质以及其在有机分子和生物分子的作用；
- 能够预测有机反应的成键方式和立体选择性；
- 能够理解和预测带有官能团有机化合物的反应活性与官能团的转换；
- 能够根据光谱数据判断出有机化合物的结构；
- 能够掌握反应机理并用以掌握地机理知识应用于解决化学问题；
- 能够应用已知的反应去合成目标分子。
- 理解生物合成和酶催化中的有机反应过程和机理

On successful completion of this course, students should be able:

- To understand basic concepts and employ the vocabulary of organic chemistry;
- To understand 3D nature of molecules, and how shape plays a role in organic molecules and biomolecules.
- To predict bonding and stereoselectivity, including chirality of organic compounds and biomolecules.
- To understand and predict the reactivity of molecules with specific functional groups and transformations of functional groups.

- To determine structures of organic compounds based on spectroscopic data.
- To be able to read and propose reasonable reaction mechanisms and apply mechanistic knowledge to solve chemistry problems.
- To apply reactions to the synthesis of targeted molecules.
- To understand the basic classes of reaction types and basic reaction mechanisms of enzymatic reactions.

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.)

Chapter 1 Introduction: What Is Organic Chemistry?

Organic chemistry and you, The origins of organic chemistry; Organic compounds; Organic chemistry and industry; Organic chemistry and the periodic table. (**1** credit hour)

第一章：绪论

有机化学和你；有机化学的起源；有机化合物；有机化学和工业；有机化学和元素周期表。1 学时

Chapter 2 Structure and Bonding; Acids and Base

Atomic structure; Chemical bonding theory; Valence bond theory; Hybrid Orbitals of Carbon; Hybridization of Nitrogen, Oxygen, Phosphorus, and Sulfur; Molecular Orbital Theory; Drawing Chemical Structures; Polar Covalent Bonds: Electronegativity and Dipole Moments; Formal Charges; Resonance; Rules for Resonance Forms; Drawing Resonance Forms; Acids and Bases: The Brønsted-Lowry Definition; Acid and Base Strength; Predicting Acid-Base Reactions from p*K*a Values; Organic Acids and Organic Bases; Acids and Bases: The Lewis Definition; Noncovalent Interactions between Molecules Acids and Base; (**3** credit hours)

第二章 结构与化学键；酸与碱

原子结构；化学键理论；价键理论；碳原子的杂化轨道；氮、氧、磷、硫原子的杂化轨道；分子轨道理论；化学结构式的画法；极性共价键：电负性和偶极矩；形式电荷；共振；共振式规则；共振式的画法；酸和碱：Brønsted-Lowry 定义；酸碱强度；依据 p*K*a 值预测酸碱反应；有机酸碱；酸和碱：Lewis 定义；酸碱分子的非共价键作用。3 学时

Chapter 3 Alkanes and Cycloalkanes and Their Stereochemistry

Functional groups; Alkanes and alkane Isomers; Alkyl groups; Nomenclature of Alkanes; Properties of alkanes; Conformation of ethane; Nomenclature of Cycloalkanes; Cis-Trans isomerism in cycloalkanes; Conformations of Cycloalkanes; Axial and equatorial bonds in cyclohexane; Conformational of Polycyclic Molecules; (**2** credit hours)

第三章：烷烃、环烷烃和其立体化学

官能团；烷烃和异构体；烷基；烷烃的命名；烷烃的性质；烷烃的构象；环烷烃的命名；环烷烃的顺-反异构体；环烷烃的构象；环己烷的直立键和平伏键；多环分子的构象。2 学时

Chapter 4 Stereochemistry

Enantiomers and the tetrahedral carbon; Chirality; Optical activity; Sequence rules for specifying configuration; Diastereomers; Meso compounds; Racemic mixture and the resolution of enantiomers; A review of isomerism. Chirality at Nitrogen, Phosphorus, and Sulfur; Prochirality; Chirality in nature and chiral environments; (**3** credit hours).

第四章 立体化学

对映异构体和四面体碳；手性；光学活性；确定构型的顺序规则；非对映异构体；内消旋化合物；外消旋混合物和对映异构体的拆分；同分异构现象概述；氮、氧、磷、硫原子的手性；前手性；自然界的手性和手性环境。3 学时

Chapter 5 An Overview of Organic Reactions

Kinds of Organic Reactions; Mechanisms; Radical Reactions; Polar Reactions; Polar Reaction: Addition of H_2O to Ethylene; Using Curved Arrows in Polar Reaction Mechanisms; Describing a Reaction: Equilibria, Rates, and Energy Changes; Bond Dissociation Energies; Energy Diagrams and Transition States; Intermediates; A Comparison between Biological Reactions and Laboratory Reactions (**3** credit hours)

第五章 有机反应概述

有机反应的种类；反应机理；自由基反应；极性反应；极性反应：水对乙烯的加成；在极性反应机理中曲线箭头的使用；反应描述：平衡，速度和能量变化；化学键解离能；能量图和过渡态；中间体；生物反应和实验室反应对比。3 学时

Chapter 6 Alkenes and Alkynes

Calculating the Degree of Unsaturation; Naming Alkenes and Alkynes; Cis-Trans Isomerism in Alkenes; Alkene Stereochemistry and the E,Z Designation; Stability of Alkenes; Electrophilic Addition Reactions of Alkenes; Orientation of Electrophilic Addition: Markovnikov's Rule; Carbocation Structure and Stability; The Hammond Postulate; Evidence for the Mechanism of Electrophilic Additions: Carbocation Rearrangements (**2** credit hours)

第六章 烯烃和炔烃

计算不饱和度；烯烃和炔烃命名；烯烃的顺-反异构现象；烯烃的立体化学和 E，Z 命名；烯烃的稳定性；烯烃的亲电加成反应；亲电加成的方向：Markovnikov 规则；碳正离子结构和稳定性；Hammond 假设；亲电加成机理的证据：碳正离子重排。2 学时

Chapter 7: Reactions of Alkenes and Alkynes

Preparing Alkenes: A Preview of Elimination Reactions; Halogenation of Alkenes; Halohydrins from Alkenes; Hydration of Alkenes; Reduction of Alkenes: Hydrogenation; Oxidation of Alkenes: Epoxidation; Oxidation of Alkenes: Hydroxylation; Oxidation of Alkenes: Cleavage to Carbonyl Compounds; Addition of Carbenes to Alkenes: Cyclopropane Synthesis; Radical Additions to Alkenes: Chain-Growth Polymers; Biological Additions of Radicals to Alkenes; Conjugated Dienes; Reactions of Conjugated Dienes; The Diels-Alder Cycloaddition Reaction; Reactions of Alkynes; (**3**credit hours)

第七章 烯烃和炔烃的反应

烯烃制备：消除反应预览；烯烃卤化反应；烯烃水合反应；烯烃还原反应：氢化；烯烃氧化反应：环氧化反应，羟化反应，断裂生成羰基化合物；卡宾与烯烃的加成；环丙烷的合成；烯烃的自由基加成反应：链增长聚合物；生物中自由基与烯烃的加成反应；共轭二烯；共轭二烯的反应；Diels-Alder 环加成反应；炔的化学反应。3 学时

Chapter 8 Aromatic Compounds

Naming aromatic compounds; Structure and Stability of Benzene; Aromaticity and the Hückel 4n + 2 Rule; Aromatic Ions and Aromatic Heterocycles; Polycyclic Aromatic Compounds; Reactions of Aromatic Compounds: Electrophilic Substitution; Alkylation and Acylation of Aromatic Rings: The Friedel-Crafts Reaction; Substituent Effects in Electrophilic Substitutions; Nucleophilic Aromatic Substitution; Oxidation and Reduction of Aromatic Compounds; An Introduction to Organic Synthesis: Polysubstituted Benzenes (**2** credit hours)

第八章 芳香族化合物

芳香族化合物的命名；苯的结构和稳定性；芳香性和 Hückel 4n + 2 规则；芳香性离子和芳杂环化合物；多环芳香化合物；芳香族化合物的反应：亲电取代；芳香环的烷基化和酰化：Friedel-Crafts 反应；亲电取代的取代基效应；亲核芳香取代；芳香族化合物的氧化和还原反应；有机合成介绍：多取代苯。2 学时

Chapter 9 Structure Determination: Mass Spectrometry, Infrared Spectroscopy, and Ultraviolet Spectroscopy

Mass Spectrometry of Small Molecules: Magnetic-Sector Instruments; Interpreting Mass Spectra; Mass Spectrometry of Some Common Functional Groups; Mass Spectrometry in Biological Chemistry: Time-of-Flight (TOF) Instruments; Spectroscopy and the Electromagnetic Spectrum; Infrared Spectroscopy; Interpreting Infrared Spectra; Infrared Spectra of Some Common Functional Groups; Ultraviolet Spectroscopy; Interpreting Ultraviolet Spectra: The Effect of Conjugation; Conjugation, Color, and the Chemistry of Vision; (**2** credit hours)

第九章 结构测定：质谱，红外光谱和紫外光谱

小分子质谱：磁质谱仪；质谱解析；常见官能团的质谱；生物化学中的质谱：时间飞行（TOF）质谱仪；光谱和电磁谱；红外光谱；红外光谱的解析；常见光能团的红外光谱；紫外光谱；紫外光谱的解析：共轭效应；共轭，颜色和视觉化学。2 学时

Chapter 10 Structure Determination: Nuclear Magnetic Resonance Spectroscopy

Nuclear Magnetic Resonance Spectroscopy; The Nature of NMR Absorptions; Chemical Shifts; ^{13}C NMR Spectroscopy: Signal Averaging and FT-NMR; Characteristics of ^{13}C NMR Spectroscopy; DEPT ^{13}C NMR Spectroscopy; Uses of ^{13}C NMR Spectroscopy; ^{1}H NMR Spectroscopy and Proton Equivalence; Chemical Shifts in ^{1}H NMR Spectroscopy; Integration of ^{1}H NMR Absorptions: Proton Counting; Spin-Spin Splitting in ^{1}H NMR Spectra; More Complex Spin-Spin Splitting Patterns; Uses of ^{1}H NMR Spectroscopy; (2 credit hours)

第十章 结构测定：核磁共振光谱

核磁共振光谱；NMR 吸收的本质；化学位移；碳谱：信号平均和傅里叶变换 NMR；碳谱的特征；DEPT 谱；碳谱的使用；氢谱和质子等价；氢谱化学位移；氢谱积分：质子数；氢谱中的自旋裂分；复杂的自旋裂分模式；氢谱的使用；2 学时

Chapter 11 Organohalides: Nucleophilic Substitutions and Eliminations

Names and Structures of Alkyl Halides; Preparing Alkyl Halides from Alkenes: Allylic Bromination; Preparing Alkyl Halides from Alcohols; Reactions of Alkyl Halides: Grignard Reagents; Organometallic Coupling Reactions; Discovery of the Nucleophilic Substitution Reaction; The S_N2 Reaction; Characteristics of the S_N2 Reaction; The S_N1 Reaction; Characteristics of the S_N1 Reaction; Biological Substitution Reactions; Elimination Reactions; The E2 Reaction and the Deuterium Isotope Effect; The E1 and E1cB Reactions; Biological Elimination Reactions (**3** credit hours)

第十一章 有机卤化物：亲核取代和消除

烷基卤化物的命名和结构；从烯烃制备烷基卤化物：烯丙位溴化；从醇制备烷基卤化物；烷基卤化物的反应：Grignard 试剂；金属有机偶联反应；亲核取代反应的发现；S_N2 反应；S_N2 反应的特征；S_N1 反应；S_N1 反应的特征；生物取代反应；消除反应；E2 反应和氘代同位素效应；E1 和 E1cB 反应；生物消除反应。3 学时

Chapter 12 Alcohols, Phenols, and Thiols; Ethers and Sulfides

Naming Alcohols, Phenols, and Thiols; Properties of Alcohols, Phenols, and Thiols; Preparing Alcohols from Carbonyl Compounds; Reactions of Alcohols; Oxidation of Alcohols and Phenols; Protection of Alcohols; Preparation and Reactions of Thiols; Ethers and Sulfides; Preparing Ethers; Reactions of Ethers; Crown Ethers and Ionophores; Preparation and Reactions of Sulfides; (**2** credit hours)

第十二章 醇，酚和硫醇与醚和硫醚

醇，酚和硫醇的命名；醇，酚和硫醇的性质；从羰基化合物制备醇；醇的反应；醇和酚的氧化；硫醇的制备；醚和硫醚；醚的制备；冠醚和离子载体；硫醚的制备和反应。2 学时

Chapter 13 Aldehydes and Ketones: Nucleophilic Addition Reactions

Naming Aldehydes and Ketones; Preparing Aldehydes and Ketones; Oxidation of Aldehydes; Nucleophilic Addition Reactions of Aldehydes and Ketones; Nucleophilic Addition of H_2O: Hydration; Nucleophilic Addition of Hydride and Grignard Reagents: Alcohol Formation; Nucleophilic Addition of Amines: Imine and Enamine Formation; Nucleophilic Addition of Alcohols: Acetal Formation; Nucleophilic Addition of Phosphorus Ylides: The Wittig Reaction; Biological Reductions; Conjugate Nucleophilic Addition to α,β-Unsaturated Aldehydes and Ketones; (**3** credit hours)

第十三章 醛和酮：亲核加成反应

醛和酮的命名；醛和酮的制备；醛的氧化；醛和酮的亲核加成；水的亲核加成：水合；氢和 Grignard 试剂的亲核加成：醇的形成；胺的亲核加成：亚胺和烯胺的形成；醇的亲核加成：缩醛的形成；磷叶立德的亲核加成：Wittig 反应；生物还原；α,β-不饱和醛和酮的共轭亲核加成；3 学时

Chapter 14 Carboxylic Acids and Nitriles

Naming Carboxylic Acids and Nitriles; Structure and Properties of Carboxylic Acids; Biological Acids and the Henderson-Hasselbalch Equation; Substituent Effects on Acidity; Preparing Carboxylic Acids; Reactions of Carboxylic Acids: An Overview; Chemistry of Nitriles (**2** credit hours)

第十四章 羧酸和腈

羧酸和腈的命名；羧酸的结构和性质；生物酸和 Henderson-Hasselbalch 方程；酸性的取代基效应；羧酸的制备；羧酸反应概述；腈的化学；2 学时

Chapter 15 Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions

Naming Carboxylic Acid Derivatives; Nucleophilic Acyl Substitution Reactions; Reactions of Carboxylic Acids; Reactions of Acid Halides; Reactions of Acid Anhydrides; Reactions of Esters; Reactions of Amides; Reactions of Thioesters and Acyl Phosphates: Biological Carboxylic Acid Derivatives; Polyamides and Polyesters: Step-Growth Polymers; (**3** credit hours)

第十五章 羧酸衍生物：亲核酰基取代反应

羧酸衍生物的命名；亲核酰基取代反应；羧酸的反应；酰氯的反应；酸酐的反应；酯的反应；酰胺的反应；硫酯和酰基磷酸盐的反应：生物羧酸衍生物；聚酰胺和聚酯：逐步增长聚合物。3 学时

Chapter 16 Carbonyl Alpha-Substitution and Condensation Reactions

Keto-Enol Tautomerism; Reactivity of Enols: α-Substitution Reactions; Alpha Bromination of Carboxylic Acids; Acidity of a Hydrogen Atoms: Enolate Ion Formation; Alkylation of Enolate Ions; Carbonyl Condensations: The Aldol Reaction; Dehydration of Aldol Products; Intramolecular Aldol Reactions; The Claisen Condensation Reaction; Intramolecular Claisen Condensations: The Dieckmann Cyclization; Conjugate Carbonyl Additions: The Michael Reaction; Carbonyl Condensations with Enamines: The Stork Reaction; Biological Carbonyl Condensation Reactions; (**4** credit hours)

第十六章 羰基 α 位取代和缩合反应

酮-烯醇互变异构；烯醇的反应：α 位取代反应；羧酸 α 位溴化；氢原子的酸性：烯醇负离子的形成；烯醇负离子的烷基化；羰基缩合反应：Aldol 反应；Aldol 产物的脱水反应；分子内的 Aldol 反应；Claisen 缩合反应；分子内 Claisen 缩合反应；Dieckmann 环化；共轭羰基加成：Michael 反应；羰基与烯胺的缩合：Stork 反应；生物羰基缩合反应。4 学时

Chapter 17 Amines and Heterocycles

Naming Amines; Properties of Amines; Basicity of Amines; Basicity of Arylamines; Biological Amines and the Henderson-Hasselbalch Equation; Synthesis of Amines; Reactions of Amines; Heterocyclic Amines; Fused-Ring Heterocycles（2 credit hours）

第十七章 胺和杂环化合物

胺的命名；胺的性质；胺的碱性；芳胺的碱性；生物胺和 Henderson-Hasselbalch 方程；胺的合成；胺的反应；杂环胺；稠环杂环化合物；2 学时

Chapter 18 Asymmetric Synthesis

Nature is asymmetric; The chiral pool; Resolution can be used to separate enantiomers; Chiral auxiliaries; Chiral reagents; Asymmetric catalysis; Asymmetric formation of carbon–carbon bonds; Asymmetric aldol reactions; Enzymes as catalysts (2 credit hour)

第十八章 不对称合成

自然界是不对称的；手性池；对映体拆分；手性辅基；手性试剂；不对称催化；碳碳键的不对称构建；不对称 aldol 反应；酶催化剂。2 学时

Chapter 19 Biomolecules: Amino Acids, Peptides, Proteins, Nucleic Acids and Lipids

Structures of amino acids; Synthesis of Amino acid; Peptides and Proteins; Peptide structure determination: Amino acid analysis; Peptide sequencing: the Edman degradation method; Peptide synthesis; Enzymes; Citrate synthase；Nucleotides and Nucleic Acids; Base Pairing in DNA: The Watson-Crick Model; DNA Synthesis; Biosynthesis of Nucleotides; Waxes, Fats, and Oils; Soap; Phospholipids; Biosynthesis of Fatty Acids; Prostaglandins and Other Eicosanoids; Terpenoids; Steroids; Biosynthesis of Steroids (2 credit hour)

第十九章 生物分子: 氨基酸，多肽，蛋白质，核酸和油脂

氨基酸的结构；氨基酸的合成；多肽和蛋白质；多肽结构的测定：氨基酸分析；多肽序列：Edman 降解方法；多肽合成；酶；柠檬酸合成酶；核苷酸和核酸；DNA 碱基对：Watson-Crick 模型；DNA 的合成；核苷酸的生物合成；蜡，脂肪和油；皂化；磷脂；脂肪酸的生物合成；前列腺素和其他类花生酸；三萜；类固醇；类固醇的生物合成。2 学时

Chapter 20 Biomolecules: Carbohydrates

Classification of carbohydrates; Fisher Projections; D, L Sugars; Configurations of Aldoses; Cyclic structures of monosaccharides: Anomers; Reactions of monosaccharides; Disaccharides; Polysaccharides and Their Synthesis; (1 credit hours)

第二十章 生物分子：碳水化合物

碳水化合物的分类；Fisher 投影式；D，L 糖；醛糖的构型；单糖的环状结构：端基差向异构体；单糖的反应；双糖；多糖和其合成。1 学时

Chapter 21: The Organic Chemistry of Metabolic Pathways

An Overview of Metabolism and Biochemical Energy; Catabolism of Triacylglycerols: β-oxidation pathway; Catabolism of carbohydrates: Glycolysis; The citric acid cycle; Catabolism of proteins: transamination; Some Final Comments on Metabolism (1 credit hours)

第二十一章 代谢途径的有机化学

代谢和生物化学能量的概述；甘油三酯的分解代谢：β-氧化过程；糖的分解代谢：糖酵解；柠檬酸循环；蛋白质的分解代谢：转氨作用；关于代谢的评论。1 学时

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

教材/Textbook: John McMurry, Organic Chemistry with Biological Applications, published by Stamford, CT: Cengage Learning, c2015; 3rd edition

参考材料/Supplementary reading: (1) Jonathan Clayden, Nick Greeves, and Stuart Warren, Organic Chemistry, published by Oxford University Press Inc., New York; Second edition. (2) 邢其毅、裴伟伟、徐瑞秋、裴坚主编。《基础有机化学》（第三版，上、下册）高等教育出版社，2005

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		10		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		10		
期中考试 Mid-Term Test		20		
期末考试 Final Exam		50		
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)		10		

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