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**	能源催化基础 Fundamentals of Energy Catalysis
2.	**授课院系** **Originating Department**	机械与能源工程系 Department of Mechanical and Energy Engineering
3.	**课程编号** **Course Code**	ME376
4.	**课程学分 Credit Value**	3
5.	**课程类别** **Course Type**	专业核心课 Major Core 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）**	丘龙斌，助理教授，机械与能源工程系 Email：qiulb@sustech.edu.cn Longbin Qiu, Assistant Professor, Department of Mechanical and Energy Engineering, Email：qiulb@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		48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	ME304 能源工程基础或 ME273 能源科学基础 ME304 Fundamentals of Energy Engineering or ME273 Introduction to Energy Science
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

本课程旨在介绍能源利用过程中的催化的原理以及各种类型催化技术的最新进展。通过课程学习，掌握能源转化过程中催化的重要性、催化的原理以及各类催化优劣的评价手段，基本熟悉各种催化转化的基本过程和关键技术。进一步，结合现阶段对新能源的开发与利用，介绍现阶段电解制备燃料、纳米催化等最新的研究进展。通过该课程的学习，让学生意识到能源转化过程中催化的重要性，学习到基本的能源催化转化原理，提升运用基础知识和基本原理解决实际问题的能力。

This course aims to introduce the principle of catalysis in the process of energy utilization and the latest development of various types of catalytic technologies. Through the course study, students can master the importance of catalysis in the process of energy conversion, the principle of catalysis and the evaluation of various catalysis, and be familiar with the basic processes and key technologies of various catalytic conversion. In addition, combined with the development and utilization of renewable energies at this stage, the latest research progress in electrolytic fuel preparation and nanocatalysis are introduced. Through the course study, students will be aware of the importance of catalysis in the process of energy conversion, learn the basic principles of energy catalytic conversion, and improve their ability to use basic knowledge and basic principles to solve practical problems.

16. 预达学习成果 Learning Outcomes

1. 掌握能源转化过程中催化的基本原理；
2. 熟悉不同类型催化的基本原理以及关键技术；
3. 熟悉传统化石燃料利用中催化转化技术；
4. 熟悉新能源利用中催化转化技术以及最新研究进展；
5. 了解能源催化的未来发展方向

1. To master the basic principles of catalysis for energy conversion;
2. To be familiar with the basic process and key technologies of different catalysis process;
3. To be familiar with catalytic conversion technology in the utilization of fossil fuels;
4. To understand the catalytic conversion technology in the utilization of renewable energies;
5. To understand the future development direction of different catalysis process for energy application.

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.)

第一部分：能源现状以及催化基本原理（4 学时）
- 全球化石能源以及新能源利用现状
- 催化基本概念及原理
- 能源催化的分类
- 催化学科的发展历史

Section 1 – Energy status and basic principles of catalysis (4 credit hours)
- Current situation of global fossil energy and new energy utilization
- Basic concept and principle of catalysis
- Classification of energy catalysis
- Development history of energy catalysis

第二部分：催化的作用以及动力学 （4 学时）
- 催化剂以及催化作用的基本概念
- 催化反应和催化剂的分类
- 吸附作用与多相催化
- 多相催化的反应动力学

Section 2 – Function of catalysis and kinetics (4 credit hours)
- Basic concept of catalyst and catalysis
- Classification of catalytic reactions and catalysts
- Adsorption and heterogeneous catalysis
- Reaction kinetics of heterogeneous catalysis

第三部分：酸碱催化与化石能源转化利用（4 学时）
- 酸碱催化的基本概念和原理
- 酸碱催化的动力学
- 甲醇制烃
- 化石能源催化转化
- 生物质催化转化

Section 3 –Acid-base catalysis and fossil energy conversion and utilization (4 credit hours)
- Basic concept and principle of acid-base catalysis
- Kinetics of acid-base catalysis
- Methanol to hydrocarbon conversion
- Catalytic conversion of fossil energy
- Catalytic conversion of biomass

第四部分：金属催化与化石能源转化利用 （8 学时）
- 金属催化的基本概念
- 天然气催化转化制燃料和化学品
- 煤催化转化制燃料和化学品
- 石油催化转化制清洁燃料和化学品
- 尾气催化转化

Section 4 –Metal catalysis and fossil energy conversion and utilization (8 credit hours)
- Basic concepts of metal catalysis
- Catalytic conversion of natural gas to fuels and chemicals
- Catalytic conversion of coal to fuel and chemicals
- Catalytic conversion of petroleum to clean fuels and chemicals
- Catalytic conversion of tail gas

第五部分：电化学催化与可再生能源转化利用 （8 学时）

- 电催化的基本概念
- 氧气相关的电催化还原与析出
- 二氧化碳的电催化还原
- 氮气的电催化还原
- 电催化制备其他燃料和化学品

Section 5 –Electrochemical catalysis and renewable energy conversion and utilization (8 credit hours)

- Basic concepts of electrocatalysis
- Electrocatalytic reduction and precipitation of oxygen
- Electrocatalytic reduction of carbon dioxide
- Electrocatalytic reduction of nitrogen
- Preparation of other fuels and chemicals by Electrocatalysis

第六部分：配位催化 （6 学时）

- 配位催化基本概念和原理
- 配位催化剂的设计与合成
- 配位催化用于烯烃聚合反应
- 过渡金属原子簇催化

Section 6 –Coordination Catalysis (4 credit hours)

- Basic concept and principle of coordination catalysis
- Design and synthesis of coordination catalysts
- Coordination catalysis for olefin polymerization
- Transition metal cluster catalysis

第七部分：酶催化（2 学时）

- 酶催化的基本概念
- 酶催化在石油化工的应用
- 酶催化在生物质降解中的应用
- 酶催化在燃料电池中的应用

Section 7 –Enzyme catalysis (2 credit hours)

- Basic concepts of enzyme catalysis
- Application of enzyme catalysis in petrochemical industry
- Application of enzyme catalysis in biomass degradation
- Application of enzyme catalysis in fuel cell

第八部分：光电催化与光制燃料 （8 学时）

- 光催化的基本概念和原理
- 光催化制氢
- 光催化还原二氧化碳制燃料（液体阳光）

Section 8 –Photocatalysis and photo-to-fuel production (6 credit hours)

- Basic concept and principle of photocatalysis
- Photocatalytic hydrogen production
- Photocatalytic reduction of carbon dioxide to fuel (liquid sunlight)

第九部分：能源催化的发展前景与发展方向（2 学时）

- 能源催化的发展方向
- 电制燃料在可再生能源利用的作用

Section 9 –Development prospect and direction of energy (2 credit hours)

- Development direction of energy catalysis
- Role of electric fuel in renewable energy utilization

第十部分：课程项目汇报 （2 学时）

Section 10- Course project report (2 credit hours)

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

教材：
能源转化催化原理，吴志杰编，中国石油大学出版社，ISBN：9787563660162
参考书：
Laszlo Guczi, Andras Erdohelyi, Catalysis for Alternative Energy Generation, Springer, 2012, ISBN: 978-1-4614-0343-2
Alessandro Lavacchi, Hamish Miller, Francesco Vizza, Nanotechnology in Electrocatalysis for Energy, Springer, 2015, ISBN: 978-1-4939-4537-5
Advanced Nanomaterials for Catalysis and Energy: Synthesis, Characterization and Applications, Vladislav A. Sadykov, Elsevier, 2019, ISBN: 978-0-12-814807-5
Catalysis for Green Energy and Technology, Samira Bagheri, Springer, 2017, ISBN: 978-3-319-43104-8

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	每次课程开始 Beginning of each class	5%		
课堂表现 Class Performance	每堂课 During the course	5%		
小测验 Quiz	随课 During the course	20%		
课程项目 Projects				
平时作业 Assignments	随课 During the course	20%		
期中考试 Mid-Term Test	学期中 Mid-term of the course	20%		
期末考试 Final Exam	学期末 End of the course	30%		
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