

上海交通大学研究生课程开设申请表

New Graduate Course Application Form, SJTU

课程基本信息 Basic Information				
*课程名称 Course Name	(中文 Chinese) 碳捕集与利用材料基础			
	(英文 English) Fundamentals of Carbon Capture and Utilization Materials			
*学分 Credits	2	*学时 Teaching Hours	32	
*开课学期 Semester	春季学期 Spring	*是否跨学期 Cross-semester?	否 No	跨 Spanning over 个学期 Semesters (含夏季学期)。
*课程性质 Course Category	专业课 Specialized Course	*课程分类 Course Type	全日制课程 For full-time students	
*授课语言 Instruction Language	英文 English	主要授课方式 Teaching Method	课堂教学 In class teaching	
*成绩类型 Grade	等第制 Letter grading	主要考核方式 Exam Method	笔试 Written Exam	
*开课院系 School	材料科学与工程学院 School of Materials Science and Engineering			
所属学科 Subject	材料科学与工程 Materials Science and Engineering			
负责教师 Person in charge	姓名 Name	工号 ID	单位 School	联系方式 E-mail
	胡志刚 Zhigang Hu	15845	材料科学与工程学院 School of Materials Science and Engineering	zhigang.hu@sjtu.edu.cn
课程扩展信息 Extended Information				
*课程简介 (中文) Course Description	<p>(分段概述课程定位、教学目标、主要内容、先修课程等；不少于 200 字。)</p> <p>世界正面临严峻的气候挑战，全球能源形势瞬息万变。要实现联合国为所有人提供可靠和可持续能源的目标，能源转型和减少碳排放至关重要。如何才能足够快速的减少 CO₂ 排放？二氧化碳捕集、利用和封存 (CCUS) 技术能否成为应对全球气候变化和可持续能源挑战解决方案的一部分？在我国 2030 碳达峰、2060 碳中和双碳目标和《氢能产业发展中长期规划 (2021-2035)》的背景下，本课程将讨论 CCUS 领域中的上述关键主题，目标帮助学生了解和掌握有助于减少碳排放的前沿材料和技术。该课程首先概述当前的全球碳排放及其来源和由此产生的气候变化问题。之后，课程将重点介绍与 CCUS 和能源转化相关的基本概念、各种应用技术和方法，介绍从陆上捕集到海上注入枯竭储层以进行储存再利用、地质/海洋储存的 CO₂ 安全运输及 CO₂ 转化成化工用品等技术。该课程包括过程工程、质量和能量平衡的基础知识，目标让学生具备对一系列工业来源的各种 CCUS 技术的理论、实际应用和评估知识。该课程将提供当前一系列 CCUS 案例，例如在油田注入 CO₂ 泡沫和用于天然气生产的 CCUS 技术，从天然气中生产氢气副产品 CO₂ 的处理和储存以及氢气的中间储存、CO₂ 的转化等。</p>			
*课程简介 (English) Course Description	<p>(须与中文一致，翻译请力求信达雅。)</p> <p>The world now is facing severe climate challenges and the global energy situation is changing rapidly. The energy transition and the reduction of carbon dioxide emissions are critical to achieving the UN's goal of providing reliable and sustainable energy for all our human beings. How can carbon dioxide emissions be reduced fast enough? Could carbon dioxide capture, utilization and storage (CCUS) technologies be part of the solution to tackle the challenges of global climate change and sustainable energy? In the context of China's 2030 carbon peak and 2060 carbon neutrality goals and the "Medium and Long-Term Plan for Hydrogen Energy</p>			

Industry Development (2021-2035)", this course will discuss the above key topics in the CCUS field to provide students with the knowledge of effective CCUS materials and technologies. In this course, we will discuss the above questions and key topics within CO₂ capture utilization and storage (CCUS) where the main goal is to develop and improve the current CCUS technologies that contribute to cut carbon emissions. The course begins with an overview of current global carbon emissions and their sources and resulting climate change issues and carbon economic policies. After that, the course will focus on basic concepts, various applied techniques, and methods related to CCUS and CO₂ energy conversion. The course will address the safe transport issues of CO₂ from onshore capture to offshore injection into depleted reservoirs for storage reuse and geological/ocean storage. This course includes fundamentals of process engineering, mass and energy balance, and equips students with theoretical, practical, and evaluation knowledge of a variety of CCUS techniques from a range of industrial practice. The course will provide a variety of current CCUS cases, such as the injection of CO₂ foam in oil wells, CCUS technologies for natural gas production, storage of CO₂ as a by-product of hydrogen production from natural gas, as well as CO₂ reduction to chemicals through photocatalysis/electrocatalysis, etc.

(建议列表形式, 各列内容: 章节、主要内容、课时数、教学方式)

*教学大纲
(中文)
Syllabus

章节	教学内容	学时	教学方式	授课教师
第一章 CCUS 概述	碳循环、氮循环、氢经济、CCUS 等	2	讲座	胡志刚
第二章 全球变暖与温室气体	全球变暖、温室气体效应、CO ₂ 与全球变暖、全球变暖解决方法等	2	讲座、小组讨论	胡志刚
第三章 碳捕集原理与技术	CO ₂ 化学吸收原理与技术	4	讲座、小组讨论	胡志刚
	CO ₂ 物理吸附原理与技术	4		
	CO ₂ 存储原理与技术	4		
第四章 碳利用原理与技术	CO ₂ 热催化转化	4	讲座、小组讨论	种丽娜
	CO ₂ 电催化转化	4		
	CO ₂ 光催化转化	4		
第五章 CCUS 展望	碳捕集技术展望	2	讲座、小组讨论	胡志刚
	碳利用技术展望	2	讲座、小组讨论	种丽娜

(须与中文一致，翻译请力求信达雅。)

*教学大纲
(English)
Syllabus

Chapters	Contents	Hours	Methods	Lecturer
Chapter 1 Introduction to CCUS	Carbon cycle, nitrogen cycle, hydrogen economy, CCUS, etc.	2	Lecture	Zhigang Hu
Chapter 2 Global warming and greenhouse gases	Global warming, greenhouse gases, greenhouse gas effect, consequences and solution to global warming, etc.	2	Lecture, Team-based learning	Zhigang Hu
Chapter 3 Carbon capture and storage principles and technologies	CO ₂ chemical absorption	4	Lecture, Team-based learning	Zhigang Hu
	CO ₂ physical adsorption	4		
	CO ₂ storage technologies	4		
Chapter 4 Carbon utilization principles and technologies	CO ₂ thermal conversion	4	Lecture, Team-based learning	Lina Chong
	CO ₂ electrocatalytic conversion	4		
	CO ₂ photocatalytic conversion	4		
Chapter 5 Prospects for CCUS	Prospects for carbon capture and storage	2	Lecture, Team-based learning	Zhigang Hu
	Prospects for carbon utilization	2	Lecture, Team-based learning	Lina Chong

*课程要求
(中文)
Requirements

(课程考核方式、考核标准等；不少于 50 字)

1. 出勤率与课堂表现 (10%)
2. 课后作业 (20%)
3. 论文与期末演讲 (30%)
4. 闭卷考试 (40%)

*课程要求
(English)
Requirements

(须与中文一致，翻译请力求信达雅。)

1. Class attendance and performance (10%)
2. Homework (20%)
3. Essay and PPT Presentation (30%)
4. Close-book exam (40%)

<p>*课程资源 (中文) Resources</p>	<p>(教材、教参、网站资料等。)</p> <p>Malti Goel (Editor), M. Sudhakar (Editor), R.V. Shahi (Editor), Carbon Capture, Storage and Utilization: A Possible Climate Change Solution for Energy Industry, 1st Edition, Kindle Edition, CRC Press, 2019. https://www.routledge.com/Carbon-Capture-Storage-and-Utilization-A-Possible-Climate-Change-Solution/Goel-Sudhakar-Shahi/p/book/9780367179083</p>
<p>*课程资源 (English) Resources</p>	<p>(须与中文一致, 请力求信达雅。)</p> <p>Malti Goel (Editor), M. Sudhakar (Editor), R.V. Shahi (Editor), Carbon Capture, Storage and Utilization: A Possible Climate Change Solution for Energy Industry, 1st Edition, Kindle Edition, CRC Press, 2019. https://www.routledge.com/Carbon-Capture-Storage-and-Utilization-A-Possible-Climate-Change-Solution/Goel-Sudhakar-Shahi/p/book/9780367179083</p>