

## 碳中和概论 (OCE 108) 课程大纲目录

1. 2023 春季学期.....	2
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## 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 <b>Course Title</b>	碳中和概论 Introduction to carbon neutrality
2.	授课院系 <b>Originating Department</b>	海洋科学与工程系 Ocean Science and Engineering
3.	课程编号 <b>Course Code</b>	OCE108
4.	课程学分 <b>Credit Value</b>	3 Three
5.	课程类别 <b>Course Type</b>	任选课 Free Elective
6.	授课学期 <b>Semester</b>	2023 春季 Spring, 2023
7.	授课语言 <b>Teaching Language</b>	英文 English
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） <b>Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	郝马克，海洋科学与工程系， <a href="mailto:mark@sustech.edu.cn">mark@sustech.edu.cn</a> Mark Hopwood, Ocean Science and Engineering, <a href="mailto:mark@sustech.edu.cn">mark@sustech.edu.cn</a>
9.	实验员/助教、所属学系、联系方式 <b>Tutor/TA(s), Contact</b>	待公布 To be announced
10.	选课人数限额(可不填) <b>Maximum Enrolment (Optional)</b>	

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
	48	0	0	0	48
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无要求 None				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无要求 None				
14. 其它要求修读本课程的学系 Cross-listing Dept.	无要求 None				

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

本课程所要介绍的主要内容包括：(1)了解双碳泵、碳中和、净零排放、蓝碳的概念；(2)培养理性分析的能力，以评估不同净零排放路线的可行性和现实前景；(3)了解温室气体在自然环境中的循环、来源、碳汇和潜在的解决技术；(4)学习如何评估作为气候解决方案而提出的不同“地球工程”技术的可行性、可扩展性、安全性和永久性的科学证据。

The main contents of this course include: (1) To understand the concepts of double carbon pump, carbon neutrality, net zero emissions and blue carbon. (2) To develop critical analysis skills to assess the viability and realistic prospects of different routes to zero emissions. (3) To understand the cycling of greenhouse gases in the natural environmental, their sources, sinks and potential mitigating technology. (4) To learn how to evaluate scientific evidence concerning the viability, scalability, safety and permanence of different 'geoengineering' techniques proposed as climate solutions.

#### 16. 预达学习成果 Learning Outcomes

1. 所有学生都能够参与到对近期文献的回顾和批评。通过每周一次的论文讨论，为学生提供有关“双碳泵”的主题信息，或提出关于应对海洋生物地球化学过程的气候解决方案。

2. 通过本课程的学习，引导学生对实现净零排放的不同途径的安全性、可行性和成本进行评述，使学生对不同技术路线的基本原理和现实前景形成自己的观点。所有学生将据此撰写出一篇短论文（1000字），对“气候解决方案”方面进行论述。

3. 学生完成本课程后能够具备必要的科研评述能力，能够就“净零排放”途径的最新科学发展发表自己的观点，为学生进入生物地球化学领域进行深入研究打好学科基础。

1. All students will participate in the reviewing and critique of recent literature. As part of the course we will discuss one research idea or paper each week which presents topical information on 'the double carbon pump' or proposes climate solutions that involve manipulating ocean biogeochemistry.

2. Through the course, we will review the safety, viability and costs of different pathways to net zero with students developing their own opinions on the rationale and realistic prospects of different technology routes. All students will produce a short essay (1000 words) critiquing as aspect of 'climate solutions'.

3. Students will complete the course equipped with the skills necessary to critique the latest scientific developments in 'net zero' pathways and will be well grounded in the underlying biogeochemical concepts positioning them to move into research in the field.

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.)**

Information Content

Overview- Introduction to marine biogeochemical cycles introducing the concept of budgets (3 hrs)

Overview- Carbon footprints (3 hrs)

Concept #1. Sources and sinks of greenhouse gases (12 hrs)

1.1 CO<sub>2</sub> emissions and budgets (2 hrs)

1.2 Geoengineering – introduction to the concept of artificial sinks (2 hrs)

1.3 CO<sub>2</sub> cycling in the environment (2 hrs)

1.4 CH<sub>4</sub> cycling in the environment (2 hrs)

1.5 N<sub>2</sub>O cycling in the environment (2 hrs)

1.6 Geological and modern day perspectives on what controls atmospheric CO<sub>2</sub> (2 hrs)

Concept #2. Pools of carbon in the ocean (8 hrs)

2.1 Inorganic carbon in the ocean – the carbonate system (2 hrs)

2.2 Primary production and carbon sinks (2 hrs)

2.3 The biological carbon pump (2 hrs)

2.4 Blue carbon (2 hrs)

Concept #3 Changing carbon fluxes (12 hrs)

3.1 Climatic feedbacks (2 hrs)

3.2 CO<sub>2</sub> fluxes, MRV – Monitoring, Reporting and Verification (2 hrs)

3.3 Carbon credits – case studies (2 hrs)

3.4 Geoengineering side effects and uncertainties (2 hrs)

3.5 Ocean iron addition (2 hrs)

3.6 Artificial upwelling – CO<sub>2</sub> sink and food source? (2 hrs)

Concept #4 Practical application of science to the question of the double carbon pump (8 hrs)

- 4.1 Case study (workshop) Could glacier rock flour be used as a geoengineering agent? (2 hrs)
- 4.2 IPCC (International Panel on Climate Change) Methods (2 hrs)
- 4.3 IPCC State of the art (2 hrs)
- 4.4 Geoengineering case study, what is the science behind [a method]? Open assignment (classic discussion and written assignment) (4 hrs)

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

会选取最近发表的文章在课堂上进行阅读和讨论（每周一次）。主要参考教材如下（网上可以免费下载）：In class we will select recently published papers for reading and discussion (one per week). The main text will be the following book (available online, PDF, free of charge):

《海洋二氧化碳去除与封存研究策略》“A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration.” National Academies of Sciences, Engineering, and Medicine; Division on Earth and Life Studies; Ocean Studies Board; Committee on A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration. A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration. Washington (DC): National Academies Press (US); 2021 Dec 8. Summary. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK580044/>

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 <b>Attendance</b>	授课期间 Throughout course	20	-	出勤率与课堂参与度 Attendance and active participation is expected
课堂表现 <b>Class Performance</b>	授课期间 Throughout course	15	-	积极参与课堂讨论和学习工作坊 Active participation in class discussion and workshops is expected
小测验 <b>Quiz</b>	-	-	-	-
课程项目 <b>Projects</b>	课堂讨论 Oral discussion in class, mini-project presentation	15	-	学生进行 12 分钟的主题文献解读 All students will give a 12 minute presentation in class on a topical paper of their choice.
平时作业 <b>Assignments</b>	课程结束后 Written assignment at end of course (1000 words)	50	-	授课教师对学生撰写的报告内容进行评分，英语语法不作为评分点。 Marks awarded for scientific content, English/grammar will not be assessed.
期中考试 <b>Mid-Term Test</b>	-	-	-	-
期末考试 <b>Final Exam</b>	-	-	-	-
期末报告 <b>Final Presentation</b>	-	-	-	-
其它（可根据需要 改写以上评估方式） <b>Others (The above may be</b>	-	-	-	-

modified as  
necessary)

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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**

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## 课程详述

### COURSE SPECIFICATION

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4.	<b>课程学分 Credit Value</b>	3 Three
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6.	<b>授课学期 Semester</b>	2024 春季 Spring, 2024
7.	<b>授课语言 Teaching Language</b>	英文 English
8.	<b>授课教师、所属学系、联系方式 (For team teaching, please list all instructors)</b> <b>Instructor(s), Affiliation &amp; Contact</b>	郝马克, 海洋科学与工程系, <a href="mailto:mark@sustech.edu.cn">mark@sustech.edu.cn</a> Mark Hopwood, Ocean Science and Engineering, <a href="mailto:mark@sustech.edu.cn">mark@sustech.edu.cn</a>
9.	<b>实验员/助教、所属学系、联系方式</b> <b>Tutor/TA(s), Contact</b>	待公布 To be announced
10.	<b>选课人数限额(可不填)</b> <b>Maximum Enrolment (Optional)</b>	

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
	48	0	0	0	48
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无要求 None				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无要求 None				
14. 其它要求修读本课程的学系 Cross-listing Dept.	无要求 None				

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《海洋二氧化碳去除与封存研究策略》“A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration.” National Academies of Sciences, Engineering, and Medicine; Division on Earth and Life Studies; Ocean Studies Board; Committee on A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration. A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration. Washington (DC): National Academies Press (US); 2021 Dec 8. Summary. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK580044/>

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	授课期间 Throughout course	25	-	出勤与课堂参与度 Attendance and active participation in class discussion is expected
小测验 Quiz	授课期间 Throughout course	25	-	检验学生的独立解题能力 Evaluate on students' independent problem-solving ability
课程项目 Projects	课堂讨论 Oral discussion in class, mini-project presentation	20	-	学生进行 12 分钟的主题文献解读 All students will give a 12 minute presentation in class on a topical paper of their choice.
平时作业 Assignments	-	-	-	-
期中考试 Mid-Term Test	-	-	-	-
期末考试 Final Exam	-	-	-	-
期末论文 Final Essay	课程结束后 At the end of course	30	-	授课教师对学生撰写的报告内容进行评分，英语语法不作为评分点。 Marks awarded for scientific content, English/grammar will not be assessed.
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**