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**	**新能源系统** **New Energy Systems**
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**	ME483
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**	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）**	林蒙 助理教授，机械与能源工程系，linm@sustech.edu.cn Meng Lin, Assistant Professor, Department of Mechanical and Energy Engineering
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	40	4	4		48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	能源工程基础（ME304） Fundamentals of Energy Engineering (MAE304)
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

本课程旨在系统的介绍新能源转换过程中的热力学、热化学和电化学基础以及其在新能源系统中的应用。熟悉新能源系统能量转换过程分析和性能优化手段。了解各类新能源能量转换过程中的理论和实际效率的限制因素。分析储能技术在能源转换过程中的作用。通过课程项目，培养学生对新能源系统能源转换过程的辩证分析能力。

This course introduces the fundamentals of thermodynamics, thermochemistry， and electrochemistry and their applications to energy conversion. Gain knowledge regarding the detailed analysis and performance optimization methods of various renewable energy conversion processes. Understand theoretical and practical limits of energy conversion among different forms and corresponding efficiencies. Learn to critically analyze renewable energy systems in the course project.

16. 预达学习成果 Learning Outcomes

1. 能够针对不同的新能源系统展开设计和理论分析；
2. 对新能源系统中的不可逆能源转换过程，能进行独立的分析；
3. 能根据需求设计高效储能系统；
4. 熟悉各类新能源系统能量转换特点；

1. Gain skills for renewable energy systems' design and performance analysis;
2. Able to independently analyse the irreversible processes in renewable energy conversion systems;
3. Design high-efficient energy storage systems on demand;
4. Familiar with the characteristics of various renewable energy conversion systems.

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：新能源基础概论 （2 学时）

- 全球能源现状及挑战
- 新能源系统基本概念

Section 1 – Introduction to new energy systems (2 credit hours)

- Global energy status and challenges
- Basic concepts for new energy systems

第二部分：能量转换的热力学基础 （4 学时）

- 能量转换中的守恒和方向性特性
- 能量转换系统基本分析方法、
- 化学反应能量转换分析

Section 2 – Thermodynamics for energy conversion processes (4 credit hours)

- Thermodynamic basics in energy conversion processes
- Basic analyzing methods for energy conversion systems
- Energy conversion analysis with chemical reactions

第三部分：能量转换过程的平衡状态分析 （4 学时）

- 理解平衡态和稳态过程
- 能量转换中的不可逆过程分析

Section 3 – Equilibrium status analysis (4 credit hours)

- Understand the equilibrium and steady state concepts
- Conversion process with irreversibility

第四部分：电化学能量转换系统分析 （4 学时）

- 理解电化学能量转换过程的热力学和动力学概念
- 电化学能源系统的一般性分析思路

Section 4 – Electrochemistry (4 credit hours)

- Understand the thermodynamics and reaction kinetics in electrochemical conversion systems
- General method in analyzing and design electrochemical energy conversion systems

第五部分：电化学电池能量转换系统 （4 学时）

- 电化学电池系统的能量转换分析
- 电池系统的热管理问题

Section 5 - Fuel Cells & Batteries (4 credit hours)

- Energy conversion process in fuel cell and battery systems
- Thermal management in fuel cell and battery systems

第六部分：光电能量转换系统 （4 学时）

- **光伏发电系统的光能吸收、载流子激发和输运概念**
- **光伏系统效率和能量损失机制**

Section 6 - Photovoltaics (4 credit hours)

- Photon absorbing, charge carriers' excitation, and transportation in PV system
- Conversion efficiency and energy loss mechanism in PV system

第七部分：地热和太阳能热利用 （4 学时）

- 地热能和太阳能热利用系统的能量转换过程分析
- 典型案例分析：太阳能海水淡化系统的能量转换

Section 7 - Geothermal/Solar Thermal (4 credit hours)

- Thermal energy conversion in geothermal and solar thermal systems
- Typical application: Energy conversion analysis for solar desalination system

第八部分：太阳能燃料生成技术 （4 学时）

- 太阳能燃料发生系统能量转换分析
- 典型案例分析：太阳能热化学循环制氢系统

Section 8 - Solar fuel technologies (4 credit hours)

- Energy conversion analysis for solar fuel generation systems
- Typical application: solar thermochemical hydrogen generation system

第九部分： 储能技术 （4 学时）

- 理解能量储存技术在能量转换应用中的重要性
- 常见储能技术的能量转换过程分析

Section 9- Energy systems with storage (4 credit hours)

- Understand the importance of energy storage
- Energy conversion process in energy storage units

第十部分： 复杂能源系统模拟技术和全生命周期分析 （4 学时）

- 复杂能源系统的流程模拟技术
- 新能源系统全生命周期分析

Section 10- System modeling and life cycle assessment (4 credit hours)

- System analysis techniques for complex energy conversion systems
- Life cycle assessment for new energy systems

第十一部分： 课程项目汇报 （2 学时）

Section 11- Course project report (2 credit hours)

课程实践：

演示实验 1：太阳能燃料发生系统示范实验 （2 学时）

- 理解电化学燃料制备系统的基本部件和系统集成
- 理解太阳能效率转换过程实验分析手段

Lab session 1- Demonstration of solar fuel generation systems (2 credit hours)

- Understand the basic components and system integration in solar fuel generation system
- Understand the experimental method for testing and analyzing solar-to-fuel efficiency

演示实验 2：相变储能系统示范实验 （2 学时）

- 相变储能材料制备和表征手段
- 储能效率的实验分析

Lab session 2- Demonstration of an energy storage unit based on phase change material (2 credit hours)

- Fabrication and characterization of phase change material
- Energy storage efficiency analysis

习题课：

习题课程 1： 课程习题讲解 (2 学时)

Tutorial 1- Assignments tutorial (2 credit hours)

习题课程 2：能源系统分析课程 (2 学时)

Tutorial 2- System analysis (2 credit hours)

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

教材：

Textbook 1: Principles of Sustainable Energy, 2nd edition, 2013, by Frank Kreith & Darrell W. Pepper;

Textbook 2: Handbook of Energy Efficiency and Renewable Energy, 2007, by Kreith, Frank , and Y. Goswami;

参考书：

Reference 1: Thermodynamics and engineering approach, 7th edition, 2011, by Yunus A. Cengel & Michael A. Boles;

Reference 2: Polymer Electrolyte Fuel Cells- Physical Principles of materials and operation, 2015, by Michael Eikerling and Andrei Kulikovsky;

Reference 3: Diffusion: Mass Transfer in Fluid Systems, 3nd edition, 2007, by E . L . Cussler;

Reference 4: Radiative Heat Transfer, 3rd edition, 2013, by Michael F. Modest.

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	10%		

	Beginning of each class			
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects	学期末 End of course	30%		
平时作业 Assignments	每次作业结束 Accessed after each assignment	50%		
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation	学期末 End of the course	10%		期末报告必须以课程项目为报告内容 The final presentation should come together with the project report.
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

机械与能源工程系教学委员会