

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	能源工程基础 Fundamentals of Energy Engineering
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	ME304
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 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)	郭亮（责任教师），机械与能源工程系 guol3@sustech.edu.cn 曾林，机械与能源工程系 zengl3@sustech.edu.cn 徐栳川，前沿与交叉科学研究院 xuzc@ntu.edu.sg
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	陈志明，11849041@mail.sustc.edu.cn
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	50

11. 授课方式 Delivery Method	讲授	习题/辅导/讨论	实验/实习	其它(请具体注明)	总学时
	Lectures	Tutorials	Lab/Practical	Other (Please specify)	Total
学时数 Credit Hours	40		16		56
12. 先修课程、其它学习要求 Pre-requisites or Academic Requirements	MSE201 材料科学基础 MAE305 工程热力学或 MAE308 传热学 MSE201 Fundamentals of Materials Science and Technology MAE305 Engineering Thermodynamics or MAE308 Heat Transfer				
	13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	ME409 化学燃料电池技术 ME411 新能源技术 MSE308 能源材料基础 EE407 能源收集技术 ME409 Chemical Fuel Cell Technology ME411 New Energy Technology MSE308 Introduction to Energy Materials EE407 Energy Harvesting Technologies			
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

通过本课程的学习，使学生深入思考能源与社会发展之间的关系，帮助学生获得必要的能源科学与技术学科的基础知识与方法，比较系统地了解先进能源转化技术及挑战，熟悉典型化石能源、新能源的资源特性与应用前景。本课程希望为能源科学与技术领域的后继英才们起到引领作用，鼓励他们关注前沿，拓宽他们的视野，加强学科交叉意识。通过理论学习、实验操作与实践观察，将有助于他们具备就不同能源系统开展研究分析、设计与优化等工作的能力。

This course intends to help the undergraduates to have a deep thinking on the relationships between energy and social development, to learn necessary fundamental knowledge and methods of energy engineering and technologies, to establish an overview on the advanced energy conversion technologies, and to understand the characteristics and application prospect of typical fossil energy sources and renewable energy technologies. This course intends to train the future leaders for the field of energy technology with a broad and cross-field perspective and without constraints by disciplinary boundaries. By using analytical, experimental and computational tools, students are expected to build their capabilities in analysis, design and optimization of different energy systems.

16. 预达学习成果 Learning Outcomes

- 1) 理解能源在社会可持续发展中的重要意义与现有挑战，对能源科学与技术产生兴趣
- 2) 掌握能源工程的科学原理与常用分析工具
- 3) 了解先进能源转化技术及瓶颈
- 4) 熟悉常用能源系统的研究分析、设计与优化过程

- 1) To well understand the importance of energy sources in sustainable social development and existing challenges, and to kindle interest in energy engineering and technology
- 2) To master the scientific principles and analysis tools of energy engineering
- 3) To understand the advanced energy conversion technologies and existing bottlenecks
- 4) To be familiar with analysis, design and optimization of common energy 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.)

理论课:	
课程内容	学时分配 (40)
<u>能源产业概况</u> 能源的分类，能源的使用现状，能源产业的发展趋势 <u>Overview of energy industry</u> Classification of energy sources, current situation of energy utilization, future development of energy industry	2
<u>热力学基础</u> 热力学四大定律，理想气体，卡诺循环，狄塞尔循环，奥图循环 <u>Basics of thermodynamics</u> The four laws in thermodynamics, ideal gas, Carnot cycle, Diesel cycle, Otto cycle	3
<u>化石燃料-煤炭</u> 煤的形成和开采，煤的清洁燃烧，高效气化和高效液化 <u>Fossil fuel-coal</u> Formation and exploration of coal, clean combustion of coal, efficient gasification and liquefaction of coal	2
<u>化石燃料-油气</u> 石油，天然气，页岩气，可燃冰的形成，开采和利用 <u>Fossil fuel-oil and gas</u> Formation, exploration and utilization of petroleum, natural gas, shale gas, and gas hydrates	2
<u>半导体物理基础</u> 半导体能带结构，电子，空穴，声子，光子及载能粒子之间的相互作用 <u>Basics of semiconductor physics</u> Band structure of semiconductors, electron, hole, phonon, photon and interaction between energy carriers	4
<u>传热学基础</u> 导热，对流，热辐射的原理及相关计算 <u>Basics of heat transfer</u> Theories of conduction, convection, radiation and the related calculation	3
<u>新能源技术-太阳能-1</u> 光电转化过程分析，光能的损失原因 <u>Advanced energy conversion technologies-solar energy-1</u> Analysis of light-to-electricity conversion, cause of optical energy loss	2
期中考试 Mid-term exam	2
<u>新能源技术-太阳能-2</u> 提高太阳能电池效率的技术 <u>Advanced energy conversion technologies- solar energy-2</u> Techniques for improving efficiency of solar cells	2
<u>新能源技术-热电材料</u> 热电转化原理，热电材料的设计与改性原则 <u>Advanced energy conversion technologies-thermoelectrics</u> Thermoelectric conversion mechanism, rules for design and improvement of	2



thermoelectrics	
<p>新能源技术-风能，水能，地热能 风能，水能，地热能的利用，地域分布和优缺点分析 <u>Advanced energy conversion technologies-wind, hydroelectric, geothermal energy</u> Utilization, geographical distribution and analysis of pros and cons of wind, hydroelectric, geothermal energy</p>	2
<p>新能源技术 - 锂电池 锂电池的化学反应原理，正极、负极、电解质材料的选择 <u>Advanced energy conversion technologies- Li-based batteries</u> Chemical reaction mechanisms in Li-based batteries, selection of materials for cathode, anode, and electrolyte</p>	3
<p>新能源技术 - 氢能与燃料电池 氢气制备与存储，燃料电池原理及应用 <u>Advanced energy conversion technologies-hydrogen and fuel cell</u> Hydrogen production and storage, working principles and applications of fuel cell</p>	3
<p>新能源技术 - 核能 核裂变反应与核聚变反应的原理，核能利用的新技术 <u>Advanced energy conversion technologies-nuclear energy</u> Mechanisms of nuclear fission and fusion, novel technologies for utilization of nuclear energy</p>	2
<p>能量工程领域创新技术概述 太阳能收集技术，辐射制冷技术，摩擦发电技术，无线能量传输技术 <u>Novel technologies in the area of energy engineering</u> Technologies for harvesting solar energy, passive cooling, triboelectric nanogenerator, wireless energy transfer</p>	3
<p>期末报告 Final presentation</p>	3
实验课：	
实验内容	学时分配 (16)
<p>发动机实验室（韩品连教授） Engine lab (Prof. Pinlian Han)</p>	2
<p>煤特性分析实验（刘科教授） Analysis of properties of coal (Prof. Ke Liu)</p>	2
<p>半导体物理实验（郭亮教授） Semiconductor physics (Prof. Liang Guo)</p>	2
<p>太阳能电池实验（徐保民教授） Solar cell (Prof. Baomin Xu)</p>	2
<p>热电材料实验（刘玮书教授） Thermoelectrics (Prof. Weishu Liu)</p>	2
<p>锂电池实验（邓永红教授） Li-based batteries (Prof. Yonghong Deng)</p>	2
<p>燃料电池实验（王海江、李辉教授） Fuel cell (Prof. Haijiang Wang and Hui Li)</p>	2
<p>参观大亚湾核电站 Visiting Daya Bay Nuclear Power Plant</p>	2

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

主要参考书 References:

- 1) Introduction to Heat Transfer (6th Edition) , THEODORE L. BERGMAN, ADRIENNE S. LAVINE, FRANK P. INCROPERA, DAVID P. DEWITT, JOHN WILEY & SONS, INC., 2011
- 2) The Laws of Thermodynamics: A Very Short Introduction, Peter Atkins, ISBN-13: 978-0199572199, Oxford, 2010
- 3) Handbook of Solar Energy: Theory, Analysis and Applications, 2016, Authors: Tiwari, G. N., Tiwari, Arvind, Shyam
- 4) Linden's Handbook of Batteries, 4th Edition, Thomas Reddy, ISBN-13: 978-0071624213, McGrawHill, New York, 2002
- 5) Handbook of Fuel Cells: Fundamentals, Technology, Applications, Wolf Vielstich (Editor) , Arnold Lamm (Editor) , Hubert A. Gasteiger (Editor), ISBN: 978-0-471-49926-8, Wiley, 2003
- 6) Lithium batteries: Science and Technology, 2003, Editors: Nazri, Gholam-Abbas, Pistoia, Gianfranco (Eds.)

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		5		
课堂表现 Class Performance		5		
小测验 Quiz		10		
课程项目 Projects				
平时作业 Assignments		20		包括家庭作业及实践课程总结 Including homework assignments and summary for practices
期中考试 Mid-Term Test		20		
期末考试 Final Exam				
期末报告 Final Presentation		40		针对新能源收集利用技术展开调研 Research of novel methods for energy harvesting and utilization
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

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