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**	热工基础 Fundamentals of Thermodynamics and Heat Transfer
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**	ME271
4.	**课程学分 Credit Value**	4
5.	**课程类别 Course Type**	专业基础课 Major Foundational 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**	无 NA
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	64		0		64

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	高等数学（下）A（MA102B）
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	太阳能热利用技术、新能源系统
14.	其它要求修读本课程的学系 Cross-listing Dept.	无

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程旨在系统的讲述能量相互转换过程的基本理论和能量传递规律，主要包含工程热力学和传热学两部分构成，介绍热能合理利用和热量传递规律，为学生后续专业课程学习和解决能源领域的工程技术问题奠定基础。 通过本课程的学习，使学生掌握热力学和传热学的基本理论知识，掌握热力学定律、工质特性、传热理论的基础上，可对各类能量转换装置进行分析，为解决能源动力、节能环保、保温散热、温湿度控制、新能源利用等实际工程问题提供支持。

This course introduces the fundamentals of energy conversion and transer.The course will cover two major parts: engineering thermodynamics and heat transfer.The course aims at training students to gain knowledge in fundamental thermodynamics and heat transfer. Based on basic principles of thermodynamics, properties of working fluids, and multi-mode heat transfer, students will be able to apply thermodynamic principles to the analysis of various energy conversion devices and hence support the solution of engineering problems in conventional energy and power systems, energy saving applications, thermal insulation and cooling, temperature and humidity control, new energy systems.

16. 预达学习成果 Learning Outcomes

1. 理解热力系统、平衡和可逆过程等基本热力学基本概念；
2. 掌握热力学基本定律，并熟练应用到热力循环分析和热力过程的分析；
3. 掌握热量传递的三种基本方式的概念和基本定律；
4. 对典型的传热现象进行分析和计算，并能对典型新能源系统进行能量分析和设计；

1. Fundamental understanding on thermodynamic systems, equilibrium and reversible processes.
2. Able to use basic thermodynamic principles to analyze thermocyles and processes.
3. Gain knowledge in the fundamentals of heat transfer mechanism.
4. Able to analyze typical heat transfer phenomena and applied the skills to new 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.)

第一部分：工程热力学与传热学概论 （2 学时）

- 热力学和传热学在能源利用中的重要作用
- 热力学的基本概念

Section 1 – Introduction to engineering thermodynamics and heat transfer (2 credit hours)

- Importance of thermodynamics and heat transfer in energy conversion processes
- Basic concepts for thermodynamics

第二部分：热力学的基本定律 （8 学时）

- 热力学第一定律基本表达式
- 闭口系与开口系能量分析
- 热力学第二定律
- 卡诺循环与熵

Section 2 – Thermodynamics: Introductory Concepts and Definitions (4 credit hours)

- Introducing the first law
- Energy balance for closed and open systems
- Introducing the second law
- Carnot Cycle and entropy

第三部分：热能转换物质的热力性质和热力过程（6 学时）

- 物质的三态及相变过程
- 理想气体与蒸汽的热力性质和热力过程
- 湿空气

Section 3 – Evaluation properties of working fluid and processes (4 credit hours)

- Thermodynamic properties and phase change processes
- Properties of ideal gas and vapor and their basics thermodynamic processes
- Psychometric

第四部分：动力循环与制冷系统（4 学时）

- 蒸汽动力循环
- 蒸汽制冷与热泵系统
- 燃气动力循环

Section 4 –Vapor power and refrigeration systems (4 credit hours)

- Vapor power systems

- Vapor refrigeration and heat pump systems
- Gas power systems
-

第五部分：热力学与新能源利用（6 学时）

- 太阳能利用中的热力学问题
- 电化学能量转换中的热力学分析
- 二氧化碳捕捉中的热力学问题

Section 5 – Thermodynamics and new energy applications (6 credit hours)

- Thermodynamic problems in solar energy systems
- Thermodynamic analysis for electrochemical system
- Thermodynamic problems in carbon dioxide capture system

第六部分：传热学绪论（2 学时）

- 传热的基本模式与物理机制
- 热力学第一定律在传热学中的应用

Section 6 – Introduction to heat transfer (2 credit hours)

- Heat transfer modes and physical origins
- Applying the first law in heat transfer

第七部分：导热（6 学时）

- 导热过程分析概论
- 稳态导热过程
- 非稳定态导热过程

Section 7 – Heat transfer by conduction (4 credit hours)

- Introduction to conduction analysis
- Steady-state conduction
- Transient conduction

第八部分：对流换热（6 学时）

- 对流问题概述
- 强制对流
- 自然对流
- 换热器设计基础
- Section 8 – Heat transfer by convection (6 credit hours)
- The problem of convection
- Forced convection
- Free convection

- Basics for heat exchanger design

第九部分：热辐射换热（8 学时）

- 辐射换热的基本概念
- 封闭表面辐射换热分析
- 太阳能热利用中的辐射问题
- Section 9 – Heat transfer by radiation (6 credit hours)
- Fundamental concepts in thermal radiation
- Radiative exchange between surfaces in enclosures
- Thermal radiation problems in solar thermal applications

第十部分：新能源利用中的热力学和传热综合分析（6 学时）

- 太阳能热利用- 海水淡化装置综合分析
- 光伏发电器件热-电耦合分析
- 燃料电池中的传热传质问题分析
- Section 10 – Thermodynamic and heat transfer analysis in new energy systems (6 credit hours)
- Solar thermal seawater desalination device
- Thermal effect in Photovoltaic systems
- Heat and mass transfer in fuel cell systems

习题课：

习题课程 1： 课程习题讲解 (5 学时)

Tutorial 1- Assignment's tutorial (5 credit hours)

习题课程 2：导热问题的数值求解 (5 学时)

Tutorial 2- Numerical solutions to conduction problems (5 credit hours)

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

Textbook 1: Moran, M. J., & Shapiro, H. M.(2003) Introduction to thermal systems engineering: thermodynamics, fluid mechanics, and heat transfer.

Textbook 2: Cengel, Y. A., & Boles, M. A. (2011). Thermodynamics: An Engineering Approach Seventh Edition.

Textbook 3: Holman, J. P. (2011). Heat transfer Tenth Edition.

Reading 1: Diffusion: Mass Transfer in Fluid Systems, 3nd edition, 2007, by E . L . Cussler;

Reading 2: 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	Beginning of each class	10%		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments	Accessed after each assignment	40%		30% 为 8 次小作业， 10%为 1 次大作业
期中考试 Mid-Term Test	8th week	20%		
期末考试 Final Exam	After 16th week	30%		闭卷考试，可以携带 1 页 A4 纸笔记
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