南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

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**	光伏光热技术导论 Introduction to Photovoltaics and Photo-thermal
2.	**授课院系 Originating Department**	材料科学与工程系 Department of Materials Science and Engineering
3.	**课程编号 Course Code**	MSE320
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业选修 major-elective Course
6.	**授课学期 Semester**	春季 Spring
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）**	何祝兵,副教授，材料科学与工程系 Dr. Zhubing He, Associate Professor, Dept. of Materials Science and Engineering 0755-88018599 hezb@sustc.edu.cn
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	46			2	48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	PHY105B 大学物理（下）B General Physics II B EE201 模拟电路 Analog Circuit 或者 MSE205 工程电路与电子基础 Foundamentals of Circuits and Electronics
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.	电子系 EE 机械系 ME

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程主要讲解太阳能的利用技术现状和前景，光伏和光热。光伏技术部分将系统的讲解单晶硅和多晶硅电池技术及工艺、硅基薄膜电池技术及工艺、CdTe 薄膜电池技术及工艺、CIGS 薄膜电池技术及工艺、有机电池技术、染料敏化电池技术、新型电池技术、逆变器和并网技术等。光热技术将介绍集热技术及工艺、集热及光热转换材料及构造等。本课程还将结合以上内容讲授工业制程控制基本概念，如 Cpk、6Ω 等技术指标。

This course will deliver the students the current technologies of using solar energy and the potentials, including photovoltaic and photothermal. In the photovoltaic part, this course mainly includes technology and processes of single crystalline silicon solar cell, silicon based thin film solar cells, CdTe solar cells, CIGS solar cells, organic solar cells, DSSC, novel compound quantum dots solar cells, inverter and grid, and etc. In the photothermal part, this course introduces the heat collecting and converting technique from solar light, the key materials and devices structures involved. In addition, basic concepts on process control are also presented in this course, such as Cpk, 6Ω.

16. 预达学习成果 Learning Outcomes

掌握太阳能电池的基本结构、性能参数。熟练运用电学模型分析太阳能电池的开路电压、短路电流、并联电阻、串联电阻、填充因子等参数的意义以及相互关系。了解单晶硅和多晶硅电池的技术发展路径、典型结构、高效电池工作原理。了解硅基薄膜叠层电池、CdTe 薄膜电池、CIGS 薄膜电池、GaAs 薄膜叠层电池的技术发展路径、光吸收层材料特性、典型结构、能带结构以及工作原理。了解有机电池、染料敏化电池、量子点电池、钙钛矿电池等新型太阳能电池典型结构、光吸收与载流子输运机理、技术发展路径。了解光伏电池成本组成、发电系统与电站组成及成本分析。了解太阳能市场格局和新技术带来的机遇。了解集热技术、材料及装备构造。

After completing this course, the students should understand the typical structure and work mechanism of solar cells and know how to utilize typical parameters of solar cells, including Voc, Isc(Jsc),series resistance, shunt resistance, fill factor, to analyse and evaluate the performance of solar cells. After learning the course, the students should be aware of the technical routes, typical physical structure, typical bandgap structure, work mechanism of the mainflow and emerging solar cell technologies,as well as the characters of absorb layer materials, including single-crystalline silicon, poly-crystalline silicon, silicon based tandem, cadmium telluride,CIGS, GaAs tandem, organic, DSSC, QDs, and perovskite solar cells. The students should also learn the cost distribution of the commercial solar cells, system and grid. Photo-

thermal technologies with popular converter materials and device configurations should be also known after study. The students should have a clear scope of current PV/PT market and opportunities turned up owing to emerging technologies.

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.)

Topic 1: **Summary on Renewable energy Development:** current renewable energies kinds, with the market share and expand route of each one, globally. (2 Credit hours)

Topic 2: **General view on PV technologies and Market now:** PN junction, typical physical structures and bandgap structures of solar cells, yield and depart of photon derived excitons, transport and recombination of carries. Electrical modes of solar cells, with such key parameters as Voc, Isc(Jsc),Rs, Rsh, FF. The characterization protocols of solar cell performance. Market research of PV in China and the world. (2 Credit hours)

Topic 3: **Crystalline Silicon Solar Cells:** the technical routes, typical physical structure, typical bandgap structure, work mechanism of single crystalline and poly crystalline silicon solar cell technologies,as well as the characters of absorb layer materials,typical manufacturing processes and the main players in the world market. (6 Credit hours)

Topic 4:**Silicon based tandem solar cells:** comparing with single crystalline silicon solar cells, the technical routes, typical physical structure, typical bandgap structure, work mechanism of silicon based tandem solar cell technologies,as well as the characters of absorb layer materials,typical manufacturing processes and the main players in the world market. (4 Credit hours)

Topic 5: **CIGS solar cells and derived**: comparing with single crystalline silicon solar cells, the technical routes, typical physical structure, typical bandgap structure, work mechanism of CIGS and derived solar cell technologies,as well as the characters of absorb layer materials,typical manufacturing processes and the main players in the world market. (4 Credit hours)

Topic 6: **CdTe solar cells**: comparing with single crystalline silicon solar cells, the technical routes, typical physical structure, typical bandgap structure, work mechanism of CdTe solar cell technologies,as well as the characters of absorb layer materials,typical manufacturing processes and the main players in the world market. (4 Credit hours)

Topic 7: **GaAs multi-junction solar cells**: comparing with single crystalline silicon solar cells, the technical routes, typical physical structure, typical bandgap structure, work mechanism of GaAs mutli-junction solar cell technologies,as well as the characters of absorb layer materials,typical manufacturing processes and the main players in the world market. (2 Credit hours)

Topic 8: **organic solar cells**: typical physical structure,and work mechanism of perovskite and QDs solar cell technologies,as well as the characters of absorb layer materials. New opportunities and challenges in study (2 Credit hours)

Topic 9: **Dye sensitized solar cells**: the technical routes, typical physical structure, typical bandgap structure, work mechanism of DSSC solar cell technologies,as well as the characters of absorb layer materials. (4 Credit hours)

Topic 10: **Perovskite solar cells**: the technical routes, typical physical structure, typical bandgap structure, work mechanism of perovskite solar cell technologies,as well as the characters of absorb layer materials. （6 Credit hours）

Topic 11: **emerging PV technologies**: typical physical structure,and work mechanism of perovskite and QDs solar cell technologies,as well as the characters of absorb layer materials. New opportunities and challenges in study. （4 Credit hours）

Topic 12: **CSP and Photo-thermal**: popular converter materials and device configurations, efficiency and market. （4 Credit hours）

Topic 13: **Inverters and PV grid system**: off-grid and in-grid PV system. （2 Credit hours）

Topic 14: **Cost**: cost of operations, balance of system, levelized cost of energy（2 Credit hours）

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

The reference readings are composed of the annual reports of the worldwide reputable research centers (UNSW ARC, NREL, Fraunhofer Institute and etc.) popular and updated literatures and supplementary books (Applied Photovoltaics,Practical Handbook of Photovoltaics Fundamentals and Applications,etc.)

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		10		
课堂表现 Class Performance				
小测验 Quiz		10		
课程项目 Projects				
平时作业 Assignments				
期中考试 Mid-Term Test		30		presentation
期末考试 Final Exam		50		
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
