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**	半导体器件物理 Semiconductor Device Physics
2.	**授课院系** **Originating Department**	深港微电子学院 School of Microelectronics
3.	**课程编号** **Course Code**	SME214
4.	**课程学分 Credit Value**	3
5.	**课程类别** **Course Type**	专业基础课 Major Foundational 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）**	周菲迟 副教授 深港微电子学院 Feichi Zhou Associate Professor, School of Microelectronics zhoufc@sustech.edu.cn 李毅达 助理教授，深港微电子学院 Yida LI Asisstant Professor，School of Microelectronics liyd@sustech.edu.cn
9.	**实验员/助教、所属学系、联系方式** **Tutor/TA(s), Contact**	蒋苓利 Lingli Jiang School of Microelectronics Jiangll@sustech.edu.cn
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	32		32		64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	EE203 固体电子学或 SME213 半导体材料物理 EE203Solid State Electronics or SME213 Semiconductor Material Physics
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	SME319 半导体器件及封装基础 SME319 Fundamentals of Semiconductor Devices and Packaging
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

本门课的目标是

理解半导体材料特性及半导体器件的基本原理

理解多种半导体器件及其发展趋势

理解半导体器件的应用领域及半导体工业

设计和仿真计算基本半导体器件

The course objectives are:

To understand the semiconductors and semiconductor devices

To understand various semiconductor devices and device trend

To understand semiconductor application and industry

To design and simulate the basic semiconductor devices

16. 预达学习成果 Learning Outcomes

能够理解半导体材料及半导体器件的物理特性及性质

能够理解半导体材料及半导体器件的工作原理

能够应用仿真工具构建传统的器件结构，包括二极管、BJT 和 MOS 晶体管。

能够应用仿真工具分析半导体器件的电气特性，包括输出特性、击穿特性、回扫特性等。

Upon completion of the course, the students will be able to demonstrate:

An understanding of physics and properties of semiconductors

An understanding of fundamentals of microelectronics and the semiconductor devices

An ability to apply simulation tools to construct conventional device structures, including diodes, BJT and MOS transistors.

An ability to apply simulation tools to analyze the electrical characteristics of the devices, including output characteristic, breakdown, snapback and so on.

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.)

理论部分

Week 1-2: 半导体物理特性及性质

Week 3-4: 半导体中载流子的统计分布

Week 5-6:半导体的导电性

Week 7-8:非平衡载流子

Week 9-10:半导体 PN 结

Week 11-12：金属半导体接触，金属绝缘体半导体电容器

Week 13-14：双极晶体管及场效应晶体管

Week 15-16: 光电子器件

Theory Part

Week 1-2: Physics and Properties of Semiconductors：

Week 3-4: Statistical Distribution of Carriers in Semiconductors

Week 5-6: Conductivity of Semiconductors

Week 7-8：Nonequilibrium Carriers

Week 9-10：PN Junction

Week 11-12：Metal-Semiconductor Contacts and Metal-Insulator-Semiconductor Capacitors

Week 13-14：Bipolar Transistors and MOSFETs

Week 15-16：Optoelectronic Devices

实验部分：

Week 1: TCAD 工具总览

Week2: Deckbuild 及 Tonyplot 操作

Week3: Silvaco TCAD 工具基本语法规则

Week4: 器件结构的 Mesh 构建

Week5: 器件构建中 Region 及 material 定义

Week6: 器件构建中掺杂, 电极及接触定义

Week7: 特性仿真中物理模型、数值计算方法及界面定义

Week8: 电学特性求解

Week9: PN 结及击穿特性仿真

Week10: 参数提取语句

Week11: 齐纳二极管仿真

Week12: PIN 二极管仿真

Week13: 三极管仿真

Week14: MOS 器件仿真

Week15: 其他器件仿真（如太阳能电池）

Week 16: 二次击穿特性仿真

Experiment Part

Week 1: Overview of the TCAD tools

Week2: Operation of Deckbuild and Tonyplot

Week3: Basic grammar rules for Silvaco TCAD tool

Week4: Mesh definition for device construction

Week5: Region and material definition for device construction

Week6: Doping, electrode and contact definition for device construction

Week7: model method and interface definition for characteristic simulation

Week8: Electrical characteristics solution

Week9: Diode and breakdown properties simulation

Week10: Extraction with the simulation tool

Week11: Zener Diode simulation

Week12: PIN diode simulation

Week13: BJT simulation

Week14: MOS simulation

Week15: Solar cell simulation

Week 16: second breakdown simulation

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

教材 Textbook：
Physics of Semiconductor Devices, 7th Edition, S. M. Sze, Kwok K. Ng
半导体物理学（第 7 版）刘恩科

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**				
小测验 **Quiz**				
课程项目 **Projects**		10		
平时作业 **Assignments**	Every two weeks	10		
期中考试 **Mid-Term Test**	Middle of the course	30		
期末考试 **Final Exam**	End of the course	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