课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	先进半导体材料/Advanced semiconductor materials
2.	**课程性质** **Compulsory/Elective**	专业选修课
3.	**课程学分/学时** **Course Credit/Hours**	3 credit /48 hours
4.	**授课语言** **Teaching Language**	英文 English
5.	**授课教师** **Instructor(s)**	王金龙/Wang Jinlong
6.	**是否面向本科生开放** **Open to undergraduates or not**	否/No
7.	**先修要求** **Pre-requisites**	否/No

8. 教学目标
Course Objectives

本课程旨在揭示和研究半导体的微观机制，并从微观角度解释半导体中发生的宏观物理现象;研究半导体的电子状态和运动规律;研究半导体中载流子的统计分布、输运理论及相关规律;了解载流子在输运过程中发生的一些宏观物理现象;并学习半导体的一些基本结构，包括半导体的金属结和表面问题。通过本课程的学习，让学生掌握主要半导体材料的性质和制备方法，了解半导体材料的最新研究进展，为今后从事半导体材料领域的工作打下基础。

The course is to reveal and study the micro mechanism of semiconductor and explain the macroscopic physical phenomena that occur in semiconductors from a microscopic point of view; to study the electronic state and motion law in semiconductors; to study the statistical distribution, transport theory and related laws of carriers in semiconductors; to learn some macroscopic physical phenomena that occur in the transport of carriers; and to learn some basic structures of semiconductors, including metal semiconductor junctions and surface problems. This course is to let students to master the nature and preparation methods of the main semiconductor materials, understand the latest development of semiconductor materials, and lay a foundation for the work of semiconductor material science in the future.

9. 教学方法
Teaching Methods

1. 课程部分章节采用英文授课，为使学生更好地学习和掌握课程内容，部分章节采用双语教学模式。
2. 在课程过程中引入互动式教学，引导学生积极主动参与教学过程，并就课程的相关授课内容进行自我展示。
3. 综述半导体材料与器件的最新研究成果和文献。

1. Some of the chapters in the course will be taught in English, while some chapters will be taught in bilingual education mode for students to better learn and master the content of the course.
2. Interactive teaching will be introduced during the course process, the students are active with full participation, and self-presentation by students are invited on the content of the course.
3. Latest research results and literature on the progress in semiconductor materials and devices will be involved and reviewed.

10. 教学内容
Course Contents

Section 1 State of electrons in semiconductors	**Lecture 1** Course introduction and general review of semiconductor materials **Lecture 2** State of electrons in semiconductors **Lecture 3** Electroconductive mechanism of holes in intrinsic semiconductors, energy band structure of silicon and germanium

Section 2 Impurities and defect levels in semiconductors	**Lecture 4** Impurities in semiconductors **Lecture 5** Defect levels in semiconductors **Lecture 6** Statistical distribution of carriers in semiconductors, carrier concentration of the intrinsic semiconductor **Lecture 7** Carrier concentration of impurity semiconductors **Lecture 8** Conductivity of semiconductors, drift mobility of carriers, carrier scattering **Lecture 9** Resistivity of semiconductors and its relation to impurity concentration and temperature **Lecture 10** Effects of a strong electric field, thermal carriers
Section 3 Non-equilibrium carriers and p-n junction	**Lecture 11** Injection and recombination of non- equilibrium carriers **Lecture 12** Lifetimes of non-equilibrium carriers, quasi-Fermi level **Lecture 13** Composite theory, trap effect, Einstein relationship of the drift motion of the carrier **Lecture 14** p-n junction, heterojunction and its band diagram, carrier transport mechanism of heterojunction
Section 4 Metal and semiconductor contacts	**Lecture 15** Metal and semiconductor contact and its energy band map, rectifier theory of metal-semiconductor contact, Ohmic contact
Section 5 Semiconductor surface and MIS structure	**Lecture 16** Surface state, surface electric field effect, capacitive voltage characteristics of the MIS structure, property of the silicon-silica system
Section 6 Photoelectric properties, photoelectricity and luminescence of semiconductors	**Lecture 17** Optical absorption and photo conductivity of semiconductors, photovoltaic effect of semiconductors, Semiconductor luminescence and laser
Section 7 Thermoelectric properties of semiconductors	**Lecture 18** Thermo-electric properties of Semiconductor, application of thermoelectric effect
Section 8 Semiconductor magnetic and piezoresistive effects	**Lecture 19** Hall effect, magnetoresistivity, photomagnetoelectric effect, electroresistive effect
Section 9 Semiconductor materials	**Lecture 20** Semiconductor materials, technical requirements for semiconductor materials, **Lecture 21** Preparation of semiconductor materials
Section 10 Semiconductor devices	**Lecture 22** Semiconductor diode **Lecture 23** Semiconductor triode **Lecture 24** Field-effect transistor

11. **课程考核**
Course Assessment

Class participation / Quiz: 15%
Homework: 25%
Midterm: 25%
Final: 35%

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

1.《半导体物理学》(第六版)，刘恩科等编著，电子工业出版社。
2.《半导体物理与器件》（第三版），Donald A.Neamen 著，电子工业出版社。