

ECE 1247: Semiconductor Device Theory

Spring, 2025-2026

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OFFICE HOURS: Mon. 13:00-15:00, Thu. 13:00-15:00 or upon appointment

LECTURES: **Section 1:**
08:15-11:00 Wed. Room S201, SCUPI Building, South Jiang'an Campus.

TEXTBOOK: Simon M. Sze, Kwok K. Ng, 4th edition, Physics of Semiconductor Devices, Wiley-Interscience

BLACKBOARD: Please regularly log on and check <https://learn.scupi.cn/>.
Lecture notes, online quizzes, assignments, announcements, and your grades will be uploaded on the ECE 1247 page of the Blackboard.

PREREQUISITE: Students are assumed to have passed Physics for Science and Engineering; Analytical Methods and Electromagnetics.

DESCRIPTION:

This course is a required core course for undergraduates majoring in Electrical and Computer Engineering & Computer Science. The main content of this course can be divided into two parts: semiconductor physics and semiconductor devices. The semiconductor physics part mainly includes electronic states in semiconductors, semiconductor material basis, carrier model, carrier transport and non-equilibrium carriers. The semiconductor devices mainly includes the relevant contact phenomena and related device principles in semiconductor devices and introduces some special effects of semiconductors. The task of this course is to reveal and study the microscopic mechanism of semiconductors and explain the macroscopic physical phenomena that occur in semiconductors from a microscopic perspective. Through the study of this course, students can comprehensively understand and master the basic concepts, knowledge theories, basic models and analysis methods in semiconductor physics and devices, laying a good foundation for students to engage in theoretical and applied research on semiconductor materials and devices related to new optoelectronics devices in the future, and providing theoretical basis for further learning other courses in related disciplines.

COURSE OBJECTIVES:

At the completion and upon the requirements of this course, students will:

- 1) Enable students to accurately explain the basic concepts, theories, basic models and analytical methods of semiconductors, and accurately describe the generation, recombination and motion laws of carriers in semiconductors.
- 2) Can accurately describe the device structure, basic principle and practical application field of pn junction diode, metal semiconductor contact Schottky diode and MOS transistor and can skillfully write and explain its current-voltage, capacitor-voltage relationship equations.
- 3) Skilled in summarizing various special effects of semiconductors, and able to use theoretical knowledge to analyze the properties of semiconductor materials.
- 4) Can give accurate interpretation of the test data of semiconductor materials and devices and judge the performance of devices according to the data.

GRADE DETERMINATION:

The final grade will be computed according to the following scheme:

Scheme:

Total grade = 20 % Assignments + 25 % Midterm Exam + 30 % Final Exam + 25 % Class Activities and Attendance and Quizzes.

Note:

All tests and final exam will be closed-book.

Conversion of numerical grades to final letter grades follows the SCUPI common grade:

A [90, 100] A- [85, 90) B+ [80, 85) B [76, 80) B- [73, 76) C+ [70, 73) C [66, 70) C- [63, 66) D+ [61, 63) D [60, 61) F (60, 0)

EXAMS:

There is one midterm exam scheduled in week 9, and one final exam during the final exam week. The midterm and final exam will be based on material taught until the test.

All exams are mandatory. There will be absolutely no makeup exam. If you miss the final, a makeup exam may be given for the final exam if the student has the approval from the instructor or emergencies and health issues with a valid proof. I will not accept the student deceleration for absence form for the final exam.

The makeup exam for the final exam would be run at the beginning of next semester and the grading will follow SCUPI common grade.

QUIZZES:

Quizzes will be given in classes irregularly. Normally, a quiz will consist of a couple of short questions.

HOMEWORK:

All assignments are accepted only in paper form.

Each assignment should be submitted in person before the next class begins.

Students should start their homework assignments immediately after the assignments are given, and DO NOT wait until the last minute to meet the deadlines. Late assignments will be NOT

accepted except for emergencies and health issues. Any other late assignments handed in will be marked but will be given 0. At most two extensions for assignments will be given in this course. All assignments will be counted in your total grade. Late submission for previous assignments during the final exam period will NOT be accepted in any form for any excuses.

ATTENDANCE:

Attendance is expected in all lectures. Valid excuses for absence will be accepted before class. In extenuating circumstances, valid excuses with proof will be accepted after class.

OTHER COURSE POLICIES:

There will be no special treatments for any students in this course.

During Class: Computers may be allowed in class for the electronic recording of notes. But please refrain from using computers for any activities that are unrelated to the course. Phones are prohibited as they are rarely useful for anything in the course. Eating and drinking are allowed in class but please keep from it affecting the course.

Academic Integrity: At Sichuan University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all the work you do. Everyone at SCUPI is expected to treat others with dignity and respect. The Code of Student Conduct allows Sichuan University to take disciplinary action if students don't follow this community expectation

APPROXIMATE SCHEDULE:

The schedule is tentative and subject to change. The sequence of the sections covered in this class is:

Week	Contents	Descriptions
1 (03/09)	Chap 0	Introductions to Semiconductor and Quantum Mechanics
2 (03/16)	Chap 1	Electronic States in Semiconductors I
3 (03/23)	Chap 1	Electronic States in Semiconductors II
4 (03/30)	Chap 2	Impurity and Defect Levels in Semiconductors I
5 (04/06)	Chap 2	Impurity and Defect Levels in Semiconductors II
6 (04/13)	Chap 3	Statistical Distribution of Equilibrium States of Carriers I
7 (04/20)	Chap 3	Statistical Distribution of Equilibrium States of Carriers II
8 (04/27)	Review & Midterm	In-class Tutorials and Review
9 (05/04)	Chap 4	PN Junction and PN Diode I
10 (05/11)	Chap 4	PN Junction and PN Diode II
11 (05/18)	Chap 5	Contact Between Metals and Semiconductors I
12 (05/25)	Chap 5	Contact Between Metals and Semiconductors II
13 (06/01)	Chap 6	Bipolar Junction Transistor (BJT) I
14 (06/08)	Chap 6	Bipolar Junction Transistor (BJT) II
15 (06/15)	Chap 7	Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET) I
16 (06/22)	Chap 7	Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET) II