Course Syllabus

[Course Code] VE510

[Course Title] Principles of Semiconductor Devices

[Term] Summer 2021

Course Description:

This course is offered to graduate students to present an in-depth overview of the principles of semiconductor devices, such as PN junctions, MOSFETs, and emerging nanoelectronic devices. It will also introduce techniques used in the fabrication of modern semiconductor devices and nanoelectronic devices as well as the principles behind them. The course covers the physics of major semiconductor devices and key processing techniques in modern semiconductor device and integrated circuits, thus equipping students with the knowledge required for engineers and scientists in the semiconductor industry. The course will also describe how recent developments in nanotechnology have enabled advanced semiconductor electronic devices. If appropriate, the course will include lab sessions for the students to realize their own design of semiconductor devices.

Instructor:

Name: Rui Yang
Email: rui.yang@sjtu.edu.cn
Phone: 34208540, ext. 4341
Office: Room 434
Office hour: Thursdays 1:30-3:30 pm

COURSE OBJECTIVES:

This course is aimed at helping students develop an in-depth understanding of semiconductor device physics and their manufacturing processes, from fundamental science to technical application. In doing so, the students will learn how to properly analyze and design semiconductor devices such as diodes and transistors, and construct process sequences that could be used to fabricate operational semiconductor devices.

If appropriate, the course intends to provide lab sessions, which can give the students an opportunity to get exposed to the advanced micro/nano fabrication processes, by leveraging the micro/nano fabrication platform (including cleanroom and equipment) in SJTU and/or JI, so that they can make their own design of the semiconductor device and realize them.

COURSE OUTCOMES:

A student who successfully fulfills the course requirements will master the following content:

1. Semiconductor fundamentals
2. PN junction
3. Schottky diodes
4. Junction transistors
5. Field effect transistors
6. Emerging nanoscale semiconductor devices
7. Semiconductor manufacturing

Textbook (Author, Book Title, Publisher, Publication Year, ISBN)**:**

Main: Semiconductor Physics and Devices: Basic Principles, 4th ed., by Donald A. Neamen.
Supplementary:
(1) Physics of Semiconductor Devices, 3rd ed., by S. M. Sze and Kwok K. Ng.
(2) Silicon VLSI Technology – Fundamentals, Practice and Modeling, by J.D. Plummer, M.D. Deal and P.B. Griffin Prentice Hall ISBN 0-13-085037-3.

Course Prerequisites:

Ve320 or equivalent (Recommended)

Course Website:

Grading Policy (Assignments %, Project, Exams, etc.)**:**

Quizzes: 10% (Random in-class quizzes)
Homework: 10%
Course project/lab: 30%
Midterm exam: 20%
Final: 30%

Honor Code Policy:

- Problem sets (homework assignments) may be discussed with partners, but the work you submit must be your own.
- Random quizzes are open book and open discussion.
- Exams will be given under the JI's Honor Code and will require individual efforts. The exams will be closed book, even though you can take some cheating paper. Scientific calculators can be used for the exams. The use of other electronic devices such as electronic dictionary and cell phone during exams will constitute an Honor Code violation. If you miss an exam, real documentation is required stating why you could not attend (severe disease, for example).
- Homework will be assigned online at Canvas as scheduled. They are usually due one week later or specified otherwise. One day automatic grace period. Second day late penalty -25%, later no credit.
- Any suspicious violation of the honor code will be reported to the honor council.

If the total grade is below 50, that will lead to fail (F).

Teaching Schedule: (Tentative and subject to change)

Week	Date	Lecture Topics	Homework: main content; may vary slightly
1	May 10	Introduction to Ve510, Semiconductor fundamentals	
	May 12	Semiconductor fundamentals	
2	May 17	PN Junction	
	May 19	PN Junction	HW1
3	May 24	PN Junction	
	May 26	PN Junction	
4	May 31	PN Junction	
	Jun 2	Schottky diodes	HW2
5	Jun 7	Schottky diodes	
	Jun 9	MOS Capacitor	
6	Jun 14	National holiday, will rearrange class	
	Jun 16	MOS Capacitor	HW3
7	Jun 21	No lecture, Midterm Exam	
	Jun 23	MOS Capacitor	
8	Jun 28	MOSFET	
	Jun 30	MOSFET	HW4

9	Jul 5	MOSFET	
	Jul 7	JFET	
10	Jul 12	BJT	
	Jul 14	Emerging nanoscale semiconductor devices	HW5
11	Jul 19	Semiconductor lab session 1	Lab report 1
	Jul 21	Semiconductor lab session 2	Lab report 2
12	Jul 26	Semiconductor lab session 3	Lab report 3
	Jul 28	Emerging nanoscale semiconductor devices	
13	Aug 2	No lecture, Final Exam	