

ECE 3200 Introduction to Semiconductor Physics

Instructor: Professor Heayoung Yoon
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TA: To be announced

Class: Monday/Wednesday/Friday 2:00 pm ~ 2:50 pm
2250 Warnock Engineering Building

Instructor's Office Hours:
MWF 2:50 pm ~ 3:30 pm
Other times scheduled by appointment via email

TA's Office Hours: To be announced

HW Review Session: To be announced

Textbook: Principles of Semiconductor Devices (Second Edition)
Sima Dimitrijevic, Oxford University Press, 2012

Prerequisites: Full major status in ECE, Permission code

Course Objective:

This introductory course will provide the background needed to understand the physics and technology of semiconductor electronic devices. By the end of the course, all students will understand:

- Crystal structure of silicon
- Introductory quantum mechanics and energy band structure
- Carrier transport in classical semiconductors
- Basics of P-N junction and metal-semiconductor junction
- Simple theory of metal-semiconductor junction, Si-MOSFET operations
- Brief overview of device fabrication processes

Homework Assignments:

There will be regularly assigned homework problems, usually one per week. All homework must be turned at the beginning of the class of the assigned due date. Late homework will be accepted **ONLY** in extraordinary circumstances and by specific arrangement with the instructor. A written email that describes the particular situation and supporting documents are required.

Your email questions would be answered within 24 hours. HW-related questions will be primarily answered by TA. It is your responsibility to present your work in a clear and logical way and with answers clearly marked. Homework solutions will be posted on the course website for approximately one week following the due date.

Exams:

There will be in-class quizzes, two mid-term exam, and a final exam. All exams will be comprehensive, covering all materials in the assigned portion of the textbook. The exams will cover the material during the lecture as well as in reading and homework assignments.

About 6 Quizzes (15 min short quiz): first quiz on January 17, Friday
Exam 1: March 6 (Friday); tentative
Exam 2: April 20 (Monday)

If you have a conflict with a scheduled exam, you should notify the instructor in advance. A written email that describes the specific situation and supporting documents are required. A make-up exam will be given on April 23, Thursday (1 pm ~ 3 pm).

Grading Policy:

The course grade will be distributed as follows:

Homework: 20 %
Quizzes: 25 %
Midterm exam: 25 %
Final exam: 30 %

Students have ultimate responsibility for their learning and must decide what actions to take to maximize progress and efficiency. Class attendance, participation in class discussion, reading the text in advance of class lectures, homework effort, independent and group study, and use of office hours may be viewed by the instructor as an indication of a student's interest and effort in learning the class materials (bonus grade: 5 %).

Disability Accommodations:

The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

University Safety Statement:

The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

Addressing Sexual Misconduct:

Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact

the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Undocumented Student Support Statement:

Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu.

Cheating Policy (following previous ECE 3200):

Just don't. Here are some things that constitute cheating:

Copying someone else's exam. If you accidentally see another student's work on an exam, WRITE a NOTE in your exam and tell me during the exam. Honesty is of great value. You will not be penalized for this. Do not pass any papers to anyone for any reason during the exam. If you use any scratch paper for doing exam problems, just staple it at the back of your exam. Loose scratch paper could look like notes passed between students.

Copying someone else's work on homework. I hope you WILL work in groups on your homework, labs, software assignments, etc. Every team member must contribute and complete each assignment / lab / homework. If you do not contribute (had to work late and couldn't make the group meeting), then do not copy their work.

Copying things (ANYthing) from a book, web, magazine, etc. Give a complete reference and clearly "quote" anything that you want to reference that someone else has done. Even if you don't use their words, but you mention or discuss their ideas, give them a reference. If you are asked to write a report or essay, it must all be in your own work. Just rearranging the words is called paraphrasing. Paraphrasing is also NOT your work.

What happens if you cheat? Under the University of Utah policy, you will receive an F in the class, be suspended from school, be fined, or be expelled from the university. So just don't cheat. (<http://regulations.utah.edu/academics/6-400.php>),

What happens if someone else cheats? Statistically, this could lower YOUR grade. Please tell the instructor or any other professor or TA (anonymously is fine) if you see instances of cheating in this or any other class. Additional guidelines that govern all courses in the University of Utah College of Engineering are found here: http://www.coe.utah.edu/wp-content/uploads/pdf/faculty/semester_guidelines.pdf

Course Outline

| Week | Topics | Book Chapter |
|-------------|---|------------------------------------|
| 1 | Crystal Structure | Ch 1. The Atomic-Bond Model |
| 2 | Energy Band Model | Ch 2. The Energy-Band Model |
| 3 | Drift / Diffusion | Ch 3. Drift |
| 4 | Drift / Diffusion | Ch 4. Diffusion |
| 5 | Generation | Ch 5. Generation and Recombination |
| 6 | Recombination | Ch 5. Generation and Recombination |
| 7 | P-N Junction | Ch 6. P-N Junction |
| 8 | P-N Junction | Ch 6. P-N Junction |
| 9 | Exam 1 | |
| 10 | Spring Break | |
| 11 | P-N Junction | Ch 6. P-N Junction |
| 12 | Metal-Semiconductor Junction | Ch 7. Metal-Semiconductor Contact |
| 13 | MOSCAP | Ch 7. Metal-Semiconductor Contact |
| 14 | MOSFET | Ch 8. MOSFET, Fabrication |
| 15 | Special Topic (Microfabrication, Optoelectronics) | Ch 12. Photonic Devices |
| 16 | Exam 2 | |