ECEN 3320 Semiconductor Devices

Department of Electrical, Computer & Energy Engineering
University of Colorado Boulder
Spring 2016

Objective
This course introduces basic concepts of semiconductor devices which form the backbone of the current integrated circuits technology. Topics to be discussed include basic semiconductor physics, p-n junction, metal-semiconductor junction and bipolar transistors and metal-oxide-semiconductor (MOS) devices.

Instructor
Won Park
Office
Engineering Center, EE 248
Phone
303-735-3601
Email
won.park@colorado.edu
Lecture Hours
10:00 ~ 10:50AM, MWF, ECCR 110
Office Hours
11:00AM ~ 1:00PM Wednesdays

Homework
10 sets of homework will be given during the Semester. Solutions will be available after homework is collected and graded.

Exams
Two mid-term exams will be given during the semester plus the final exam.

Grading
Homework - 40%, Mid-Term - 2 x 15%, Final - 30%

Website
http://ecee.colorado.edu/~wpark/
Class notes, homeworks and occasional announcements will be posted here.

Prerequisite
Circuits/Electronics 3 (ECEN 3250) or equivalent is required.

Textbook
B. Van Zeghbroeck, Principles of Semiconductor Devices
R. S. Muller, Device Electronics for Integrated Circuits, 3rd Ed.
John Wiley & Sons, 2003. (Reserved at Engineering Library)

References
ECEN 3320
Semiconductor Devices

Tentative Schedule

Week 1 (VZ Chap. 2.1 ~ 2.4)
- Overview of course and expectation
- Crystal structure
- Energy band structure
- Density of States
- Homework #1

Week 2 (VZ, Chap. 2.5 ~ 2.6)
- Equilibrium Distribution Functions
- Carrier statistics in Equilibrium
- Intrinsic and extrinsic semiconductors
- Non-Equilibrium Statistics
- Homework #2

Week 3 (VZ, Chap. 2.7)
- Drift and Diffusion Current
- Hall Effect
- Homework #3

Week 4 (VZ, Chap. 2.8 ~ 2.9)
- Generation and Recombination of Carriers
- Continuity Equation 1
- Homework #4

Week 5 (VZ, Chap. 4.1 ~ 4.3)
- Continuity Equation 2
- pn Junction
- Electrostatic Analysis
- Mid-Term Exam #1

Week 6~7 (VZ, Chap. 4.4 ~ 4.5)
- Current in pn Junction
- Junction Breakdown
- Homework #5,6

Week 8 (VZ, Chap. 4.6 ~ 4.10)
- Optoelectronic Devices

- Homework #7

Week 9 (VZ, Chap. 3.1 ~ 3.3)
- Schottky Diode
- Electrostatic Analysis
- Homework #8

Week 10 (VZ, Chap. 3.4 ~ 3.5)
- Current in Schottky Diode
- Ohmic Contact
- Homework #9

Week 11
- Spring Break

Week 12 (VZ, Chap. 5)
- Bipolar Junction Transistor
- Mid-Term Exam #2

Week 13 (VZ, Chap. 6.1 ~ 6.4)
- MOS device
- Operating Principle
- MOS under bias

Week 14 (VZ, Chap. 6.5 ~ 6.6)
- MOS analysis
- Non-ideal MOS devices
- Homework #10

Week 15 (VZ, Chap. 7.1 ~ 7.4)
- MOSFET operation
- MOSFET analysis

Week 16 (VZ, Chap. 7.4 ~ 7.7)
- Threshold voltage
- MOSFET circuits
- Advanced MOSFET topics

Final Exam:
Tue., May 3, 1:30 ~ 4:00PM
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Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, students with religious obligations that may cause conflicts with the course proceeding are requested to talk to the instructor within the first two weeks of the semester. See full details at http://www.colorado.edu/policies/fac_relig.html

Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at http://www.colorado.edu/policies/classbehavior.html and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html #student_code
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