ECEN 5355 Principles of Electronic Devices 1

Department of Electrical and Computer Engineering
University of Colorado at Boulder
Spring 2018

Objective
This course introduces basic concepts of electronic devices which form the backbone of the current integrated circuits technology. Topics to be discussed include basic semiconductor physics, p-n junction, and structures and performance of 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, Room ECEE 265
Office Hours
By appointment.

Homework
7 sets of homework will be given during the Semester. Solutions will be made available after homeworks are collected and graded.

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

Grading
40% - Homework, 25% - Mid-Term, 35% - Final Exam

Website
http://ece.colorado.edu/ecn5355/
Class notes, homeworks and solutions will be posted here. All homeworks should be submitted to D2L.

Prerequisite
Undergraduate level semiconductor device course (ECEN 3320 or equivalent) is required.

Textbook
B. Van Zeghbroeck, Principles of Semiconductor Devices
Textbook will be placed on reserve at the Engineering Library.

References
ECEN 5355  
Principles of Electronic Devices 1

Tentative Schedule

Week 1 – 2: Semiconductor Physics
- Theory of Solid
- Carrier Statistics
- Currents in Semiconductors
- Reading: M&K pp.2-38
- Homework #1

Week 3 – 4:
- Metal-Semiconductor Junction
  - Schottky Contact
  - Ohmic Contact
  - Surface Effects
  - Reading: M&K pp.140-169
  - Homework #2

Week 4 – 6: p-n Junction (1)
- Basics of p-n Junction
- Reverse Biased p-n Junction
- Junction Breakdown
- Field-Effect Transistor
- Reading: M&K pp.175-221
- Homework #3

Week 6 – 8: p-n Junction (2)
- Continuity Equations
- Currents in p-n Junction
- Charge Storage Characteristics
- Review and Discussion (Mar. 9)
- Reading: M&K pp.227-262 & 268-273
- Homework #4

Week 9
- Mid-Term Exam (Mar. 16)

Week 9 – 10:
- Quantum Structures
  - Quantum Well
  - Quantum Dot
  - Light Emitting Diode
  - Laser Diode
  - Photodiode
  - Solar Cells

Week 11: Spring Break

Week 12:
- Bipolar Junction Transistor
  - Reading: M&K pp.279-342
  - Homework #5

Week 13 – 14:
- Metal-Oxide-Semiconductor (MOS) Device
  - Ideal MOS device
  - Capacitance Characteristics
  - Non-ideal Effects
  - Reading: M&K pp.381-421 (Skip Section 8.6)
  - Homework #6

Week 15 – 16:
- MOS Field Effect Transistors
  - Basic MOSFET operations
  - Short-Channel Effects
  - Complementary MOS (CMOS)
  - Reading: M&K pp.429-475
  - Some Advanced Topics
  - Homework #7
  - Review and Discussion (Apr. 30 & May 2)

Final Exam
Sun., May 6, 1:30 – 4:00pm
Disability
If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and http://www.Colorado.EDU/disabilityservices
If you have a temporary medical condition or injury, see guidelines at http://www.colorado.edu/disabilityservices/go.cgi?select=temporary.html
Disability Services' letters for students with disabilities indicate legally mandated reasonable accommodations. The syllabus statements and answers to Frequently Asked Questions can be found at http://www.colorado.edu/disabilityservices

Religious Observances
Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, I ask students to come to me to discuss any possible conflicts at the beginning of the semester so that proper arrangements can be made. See full details at http://www.colorado.edu/policies/fac_relig.html

Classroom Behavior
Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, 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
### Discrimination & Harassment

The University of Colorado at Boulder policy on Discrimination and Harassment, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships apply to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of sexual harassment or discrimination or harassment based upon race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH, the above referenced policies and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at [http://www.colorado.edu/odh](http://www.colorado.edu/odh).

### Honor Code

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at [http://www.colorado.edu/policies/honor.html](http://www.colorado.edu/policies/honor.html) and at [http://www.colorado.edu/academics/honorcode/](http://www.colorado.edu/academics/honorcode/).