ECE 441  
Physics and Modeling of Semiconductor Devices  

Professor Wenjuan Zhu  
Spring Semester 2017

Course Overview
This course focuses on the derivation of models for the terminal currents of the semiconductor devices used in integrated circuits, specifically, the MOSFET and bipolar junction transistor. Our objective will be to represent the device’s steady-state response; however, we will also discuss how to extend the models to the transient case. On an as-needed basis throughout the semester, we will study semiconductor physics, focusing on topics such as drift and diffusion, generation and recombination, and avalanche multiplication. In the latter part of the semester, we will explore the motivations behind recent modifications to the basic transistor structures, such as the adoption of high-k gate dielectrics for MOSFETs.

Lectures  
MWF 11:00–11:50 AM, 3013 ECEB

Important Dates
Midterm 1: Friday, February 24  
Midterm 2: Wednesday, April 19  
Final Exam: Thursday, May 11, 8:00-11:00 a.m.

Grading
Weekly Homework 20%  
TCAD Assignments 10% (5% each)  
Midterm Exams 30% (15% each)  
Final Exam 40%

Instructor Office Hours*
Tuesday 4:00 pm – 5:00 pm, MNTL 3258  
*I occasionally need to shift my office hours to accommodate prelim exams, travel, etc., so always check the class webpage before coming to office hour on any given day. Any changes to my office hours will be listed under “Announcements.”

Teaching Assistant  
Zaichen Chen (zchen19@illinois.edu)  
Office hours: Wed. 10-11am and Thu. 3-4pm, at ECEB 2036

Textbook  

Homework Policy
Homework is due in class each Wednesday, preferably before the lecture begins. If you will not be able to attend class due to a job interview, conference trip, etc., you may turn in your homework early by giving it to the TA or the instructor, either in person or as an email attachment. Late homework will not be accepted. Each student’s lowest homework grade of the semester will be dropped before the semester total score is calculated. A student who is seriously ill for more than 7 consecutive days should contact
the instructor so that s/he is not unduly penalized for missing multiple homeworks. Homework is to be the student’s own work, not a collaborative or plagiarized work. However, students are permitted and encouraged to help one another by engaging in discussion of the course material and approaches to solving the homework problems.

**Class Website and Web-board**
http://courses.engr.illinois.edu/ece441. Homework and exam solutions will be posted on the class website, as will copies of any slides shown in class. If you have a question regarding a homework assignment or an exam, post the question on the class web-board; you may link to the ECE 441 web-board from the class homepage. The web-board is the primary means for student-staff communication outside class and office hours. Email should be used only for matters of a personal nature. The web-board will be checked on a daily basis.

**List of Topics**
We will cover the following topics. Relevant sections of the textbook are noted in parentheses. Exact reading assignments will be given on the weekly homework sheets.

- Semiconductor Physics (1.1, 1.2)
- Numerical Simulation (2.9)
- Metal-Semiconductor Contacts (3.1-3.4)
- PN junctions (4.1-4.3, 5.1-5.4)
- MOS Capacitor (8.1-8.5)
- MOSFET (9.1-9.4, 10.1, 10.5)
- Bipolar Transistor (6.1-6.5, 7.1-7.6)

Some of the lectures will cover material that is not in the textbook, so attendance is expected. Smart-phones and other communication devices must be turned off while you are in my classroom.