Course Overview
This course focuses on the derivation of models for the terminal currents of the semiconductor devices used in integrated circuits: diode, bipolar junction transistor and MOSFET. 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 10:00–10:50 AM, 3081 ECEB

Important Dates
Midterm 1: Wednesday, February 20
Midterm 2: Monday, April 1
Final Exam: Friday, May 3, 1:30 pm

Grading
Weekly Homework 25%
TCAD Assignments 10% (5% each)
Midterm Exams 30% (15% each)
Final Exam 35%

Instructor Office Hours*
Tuesday 11:00 am – 12:00 noon, 407 CSL
Thursday 3:00 - 4:00 pm, 407 CSL
*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
To be determined

Textbook

Homework Policy
Homework will be due in class on most Wednesdays, 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 Discussion Forum
http://courses.engr.illinois.edu/ece441. The website will be setup when a TA is assigned or in the second week of classes, whichever comes first. Also, a discussion forum, perhaps piazza, will be setup. 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 discussion forum. The discussion forum is the primary means for student-staff communication outside class and office hours. Email should be used only for matters of a personal nature.

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, 5.1)
- Numerical Simulation (2.9)
- Metal-Semiconductor Contacts (3.1-3.4)
- Quasi-neutral Approximation (4.1)
- Depletion Approximation (4.2)
- Generation and Recombination (5.2)
- PN Junction Diode (4.3, 5.3, 5.4)
- Bipolar Transistor (6.1-6.5, 7.1-7.6)
- MOS Capacitor (8.1-8.5)
- MOSFET (9.1-9.4, 10.1)

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