ELEG 4203 – SEMICONDUCTOR DEVICES

Credits and Contact Hours
Three credit hours, 45 hours of instructor contact, Two 75-minute classes every week.

Instructor’s Name
Shui-Qing (Fisher) Yu, Assistant Professor

Textbook

Specific Course Information

a. Other supplemental materials
Instructor Lecture Notes

Specific Goals for the Course
1. Specific outcomes of instructions
   Students are expected to understand the basic working mechanisms in semiconductor diodes, and bipolar and field-effect transistors in order to build device models for analysis and design through simulations.
2. Indicate the student outcomes listed in Criterion 3 addressed by the course
   (a) An ability to apply knowledge of mathematics, science, and engineering
   (b) An ability to design and conduct experiments, as well as to analyze and interpret data
   (c) An ability to design a system, component, or process to meet desired needs
   (e) An ability to identify, formulate, and solve engineering problems
   (k) An ability to use the techniques, skills, and modern engineering tools (this specifically includes PSPICE and MATLAB) necessary for engineering practice

List of Topics
1. Crystal lattices, diamond structure, silicon crystals. (2 classes)
2. Electronic structure of atoms, Bohr model, basic quantum mechanics, and drift of electrons and holes. (4 classes)
3. Electrons and holes in semiconductors, band diagram, excess carriers, and diffusion of electrons and holes. (4 classes)
4. P-N junctions, forward and reverse- biased junctions, conduction mechanisms, capacitance, and breakdown mechanisms. (6 classes)
5. Field-effect transistors, basic operation of MOSFET, Ideal MOS structure, threshold voltage, C-V analysis, output and transfer characteristics, effect of real surfaces, threshold adjust, substrate bias effect, and short channel effects. (7.5 classes)
6. Bipolar junction transistors, solution of diffusion equations, terminal currents, models, switching, high injection, base narrowing, breakdown, and high frequency transistors. (5.5 classes)