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

Semiconductor Devices, Sima Dimitrijev, 2nd Edition, Oxford University Press 2012.

a. Other supplemental materials
Semiconductor Device Fundamentals, R.F. Pierret, Addison-Wesley, 1996.
Solid State Electronic Devices, Ben G. Streetman, Sanjay Kumar Banerjee, 6th edition.
Instructor Lecture Notes

Specific Course Information

a. Catalog description: Crystal properties and growth of semiconductors, energy bands and charge carriers in semiconductors, excess carriers in semiconductors, analysis and design of p/n junctions,, analysis and design of bipolar junction transistors, analysis and design of field-effect transistors.
b. Pre-requisites or co-requisites: MATH 3404.
c. Required or Technical Elective: Technical Elective

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)