ECE 416/ECE 516 – Electronic Materials & Devices

Catalog Description: Semiconductor fundamentals and physical principles of pn junctions and Schottky barrier diodes.

Credits: 4 **Terms Offered:** Fall

Prerequisites: ENGR 201

Courses that require this as a prerequisite: ECE 417, ECE 418

Structure: Two 80-minute lectures and a 50-minute recitation per week

Instructors: J. F Conley (primary), P. Dhagat (secondary)

Course Content:
- Semiconductor fundamentals: bond model and energy band model of a semiconductor, doping, carrier concentrations, mobility and resistivity of a semiconductor
- Semiconductor non-equilibrium: drift and diffusion of electrons and holes in semiconductors, electron-hole pair generation and recombination mechanisms, continuity equations
- P-N junctions: fabrication, built-in voltage, electrostatics, and current-voltage (I-V) characteristics, capacitance-voltage (C-V) characteristics, small-signal modeling, transient response, SPICE models, 1-D and 2-D device simulation using computer aided design/analysis software
- Metal-semiconductor junctions: fabrication, built-in voltage, electrostatics, current-voltage (I-V) characteristics, capacitance-voltage (C-V) characteristics, and SPICE models

Measurable Student Learning Outcomes:
At the completion of the course, students will be able to…
1. **Calculate** the carrier concentrations and resistivity of a semiconductor using the given doping concentration and design a resistor of a given value (ABET outcomes a, c, m)
2. **Explain** carrier generation and recombination processes in semiconductors.
3. **Analyze** charge carrier transport in one-dimensional semiconductor structures using drift-diffusion equations.
4. **Draw** the energy band diagram of a p-n junction diode, **extract** its SPICE model parameters from the given current-voltage (I-V), and **relate** the SPICE model parameters to the physical parameters of the device (ABET outcomes a, b, k, m).
5. **Prepare** a report on a project involving the analysis/design of a semiconductor device using computer-aided design tools. (ABET Outcomes a, c, e, g, k, m, p)
6. **ECE 516: Critically review** a journal paper topically related to the course.

Learning Resources:
- *Semiconductor Device Fundamentals*, R.F. Pierret, Addison Wesley, 1996

Evaluation of Student Learning:
- 416: 50% midterm exams (2), 25% final exam, 15% project, 10% homework
- 516: 40% midterm exams (2), 25% final exam, 15% project, 10% homework, 10% paper review

Students with Disabilities:
Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098.

Link to Statement of Expectations for Student Conduct, i.e., cheating policies
http://oregonstate.edu/admin/stucon/achon.htm

Revised: 04/18/11