**Goals:** To present the theoretical and practical background of device physics so that students understand and are able to design and optimize the charge transport properties of semiconductor materials and devices.

**Instructor:** Dr. Jing Guo (NEB 551, guoj@ufl.edu)

**TA:** Kelli Borowski (klborowski@ufl.edu)

**Text (required):** 

**References:**
- Semiconductor Device Fundamentals
  Pierret, Robert F.
  Addison-Wesley, 1996

**Office hours:**
- Dr. Guo: 2-4pm Wed. or by email appointment (NEB551), Email: guoj@ufl.edu
- TA (Kelli Borowski): 4th period (10:40-11:30), Tuesday and Thursday (NEB 222)
  Email: klborowski@ufl.edu

**Lab hours (NEB 289, only in specific weeks TBD):**
- Session 1: Monday, 6th period (12:50-1:40pm)
- Session 2: Monday, 7th period (1:55-2:45pm)

**Topics:**
**Crystal Properties of Semiconductors - Chap. 1**
- Semiconductor materials
- Crystal Lattices

**Charge Carriers in Semiconductors- Chp. 3**
- Energy Band Model
- Bonding Model
- Carrier Energy Distributions
- Carrier Concentrations
- Fermi Level in Equilibrium
- Carrier Drift in Electric Fields

**Excess Carriers in Semiconductors -Chp. 4**
- Optical Absorption & Recombination
- Carrier Lifetime & Photoconductivity
Quasi-Fermi Levels
Carrier Diffusion
Drift & Diffusion
Einstein Relation

**Junctions - Chp.5**
Contact Potential
Forward & Reverse Bias
Diode Equation
Reverse Bias Breakdown
Junction Capacitance

**Field-Effect Transistors - Chp.6**
MOSFET Basic Concepts
Ideal MOS Capacitor
Threshold Voltage
Capacitance vs. Gate Voltage
Real Surface Effects
MOSFET Voltage/Current Relations
Frequency Response

**Bipolar Junction Transistors - Chp. 7**
BJT Basic Concepts
Current Distribution Diagrams
Emitter Injection Efficiency
Current Amplification Factor
Base Charge Transit Time/Lifetime
Common Emitter Amplification
Heterojunction Bipolar Transistor

**Optoelectronic Diodes - Chp. 8**
Photodetectors
Solar Cells
Light Emitting Diodes (LEDs)

**Labs:**
(1) Lab on bandstructure of semiconductor materials
(2) Lab on fabrication technology and process simulation
(3) Lab on PN junction
(4) Lab on Optoelectronic Devices (specifically on LEDs)
(5) Lab on Metal-Oxide-Semiconductor Capacitors (MOS capacitors)
(6) Lab on MOSFETs.
**Grading:**
Tests I, II, and III count for 25% each, but only the two highest scores will be used. You may drop one. The final exam, cumulative, counts for 25% and the homework for 10%. Lab reports count for 15%. The overall class average will determine the B-/ B breakpoint. The A range will start one standard deviation above this point, the C- range one standard deviation below.

**Partial credit:**
The following policy for test and quiz partial credit applies.
1. All requests for partial credit should be directed, in writing and documented, to Prof. Jing Guo within one week after the work has been returned.
2. You will only receive credit for work handed in for grading.
3. You can not receive full credit for wrong answers.

**Academic Honesty Statement:**
All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a student at the University of Florida and to be honest in all work submitted and exams taken in this class and all others.