GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering
ECE 3450: Semiconductor Devices
Fall 2026

Prerequisites: ECE 3040 Microelectronic Circuits

Professor: Dr. William D. Hunt, Professor
Office/Hours: Room 221, Pettit Microelectronics Research Center
email: bill.hunt@ece.gatech.edu
Time: Thursdays 1pm to 4pm

Grading:

Homework	15%
Exam1	20%
Exam 2	20%
Class Project Pres	20%
Final Exam	25%

Objective: **Course Objectives:**

- understand the physical, electrical and optical properties of semiconductor materials and their use in microelectronic circuits
- relate the atomic and physical properties of semiconductor materials and structures to device operation
- develop a deeper understanding of the connection between material properties, layer structures and device topologies, and semiconductor device performance

Course Outcomes—Be able to:

- Analyze semiconductor quantum wells and quantum mechanical structures qualitatively and quantitatively.
- Describe the interactions of photons, phonons, and electrons in semiconductors.
- Describe heterojunctions in semiconductor systems: metal-semiconductor junction and semiconductor heterojunctions.
- Analyze switching characteristics of rectifiers using PN diodes as an example.
- Analyze short channel effect and the frequency response of field-effect transistors.
- Analyze d.c. operation and the frequency response of bipolar transistors.
- Describe operating principles of semiconductor-based light sources and photodetectors

Homework: Homework assignments will be collected at the end of class on the day they are due at which time a solution set will be handed out. **No late homework assignments will be accepted.** You are welcome, and even encouraged, to work together on the homework assignments but **do not** just copy someone else's work. Working problems is one of the best way to learn.

Project: Soon you will form into groups of 4 or 5 and come up with a project that is semiconductor devices related. You will submit an abstract regarding your project within a month of the inception of the semester. Once approved you will be free to proceed. The project presentation will be on the final class day and the "report" will be in the form of a powerpoint.

Exams: There will be two exams during the semester. The exams will be closed book, closed notes but you can bring in one 3"x5" index card of notes and formulas to each exam. You may bring three 3"x5" index cards to the final exam. In no case will a make-up quiz be given unless be given unless the student has obtained

approval from me at least two weeks prior to the announced time of the quiz. **All exam and homework grades become final one week after they are returned in class.**

Attendance: You are responsible for all topics, discussions, handouts and announcements made in class.

Text: Anderson, Betty, and Richard Anderson. *Fundamentals of semiconductor devices*. McGraw-Hill, Inc., 2018.

Highly Recommended: ***Mathematical Handbook***, Murray Siegel, McGraw-Hill (Schaum's Outline Series) 1968(*i.e.* the summer before Woodstock).
Mathematical Methods for Physicists, Seventh Edition: A Comprehensive Guide, George B. Arfken and Hans J. Weber, Academic Press, 2012. (Any Edition is actually fantastic and should be in your personal library)

Week	Topics	Reading Material
1	Electron energy, electronic states, band structure, donors and acceptors	Ch. 1,2
2	Effective mass, density of states, Fermi statistics, drift, diffusion, current continuity, recombination, generation	Ch. 1,2
3	**Institute Holiday: Labor Day**	
3	Nonuniform doping, non-uniform composition, thermal equilibrium, p-n junctions: qualitative	Ch. 4, 5.1, 5.2
4	p-n junctions: quantitative, small signal modeling, large signal transients, effect of temperature Class Project Abstract Due	Ch. 5.3-5.7
5	Linear and hyperabrupt homojunctions, heterojunctions	Ch. 6.1-6.3
5	**Exam # 1**	
6	Shottky contacts, junction capacitance, wave functions, probability and amplitude, Schroedinger equation	Ch. 6.4-6.7, S1, lecture notes
7	Schroedinger equation applications	S1, lecture notes
8	**Institute Holiday: Fall Break**	
8	Photodiodes, LEDs	Ch. 11
9	laser diodes, image sensors	Ch. 11
10	Bipolar junction transistors: terminal characteristics, modeling, doping gradients	Ch. 9.1-9.5
10	**Exam #2**	
11	Bipolar junction transistors: terminal characteristics, modeling,	Ch. 9.1-9.5

	doping gradients	
12	Heterojunction bipolar junction transistors (HBTs) , MOSFETs: qualitative	Ch. 9.6-9.9 Ch. 7.1-7.2
13	Advanced MOSFET technologies	Ch. 8.5-8.8
14	MOSFETs: quantitative, advanced concepts	Ch. 7.3-7.8
15	Advanced MOS devices	Ch. 8.5, 8.6
15	**Institute Holiday: Thanksgiving**	
16	Thyristors, power MOSFETs, IGBJTs Class Project Presentation	Ch. 12.3-12.7
17	Final Exam:	