

ECE 430/530 Solid-State Devices

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Course level: graduate students and senior undergraduate students

Prerequisite: PHY 253 and ECE 330

Lectures: MWF 11:00 am - 11:50 am, SEC, room 3437

Office hours: Per appointment

Course description

ECE 430/530 (Solid-State Devices) is devoted to the study of solid-state devices based on the principles of solid-state physics. Devices for study include PN junction, Schottky diodes, BJTs, MOSFETs. The objective of this course is to gain an in-depth understanding of solid-state devices, in particular their non-ideal behaviors and electrical characterizations.

Topics to be covered (tentative, subject to change):

Part I: Semiconductor Materials and Solid-State Physics

1. Energy band, energy vs. momentum diagram, and effective mass
2. Density of states, Fermi-Dirac statistics, doping
3. Drift and diffusion current, mobility and scattering
4. Continuity equation (**Midterm exam**)

Part II: Solid-State Devices

5. PN junction
6. Schottky diode
7. BJT
8. MOS-capacitor and MOSFET (**Final exam**)

Part III: Material and Device Characterization

1. Resistivity: two-point versus four-point probe
2. Hall effect: carrier mobility and doping density
3. Carrier lifetime
4. Contact resistance and Schottky barrier
5. Current-voltage (I-V) and capacitance-voltage (C-V) measurement

(Graduate students presentation)

Required textbook

- B.L. Anderson and R.L. Anderson, *Fundamentals of Semiconductor Devices*, McGraw-Hill Education, 2nd edition, 2017.

Reference books (on reserve in Science and Engineering Library):

- Richard S. Muller, Theodore I. Kamins, Mansun Chan, *Device Electronics for Integrated Circuits*, Wiley, 3rd Edition, 2002.
- Dieter K. Schroder, *Semiconductor Material and Device Characterization*, Wiley- IEEE Press, 3rd Edition, 2006.

Homework and exam policy

- Homework is due in class. Late homework will NOT be accepted for any circumstances (no excuse policy).
- Exams will be completed individually in class (close book exams). No alternate exams will be provided except under dire circumstances.
- Discussion in small groups is encouraged for homework. However, each student should work through problems individually.
- Graduate students are expected to do additional work by providing research presentation during or at the end of semester.

Grading	Graduates (530)	Undergraduates (430)
Homework (approximately 5)	20%	20%
Midterm exam	30%	30%
Final exam	40%	40%
Graduate presentation	10%	
Attendance		10%