

## ECE344 Semiconductor Devices and Materials Fall 2009

Day and Time: MWF 11:15-12:05  
Place: ELAB 304  
Prerequisite: **ECE212 (passed with a grade of C or better)**. The material covered in PHYS 152, MATH 233 and MATH 331 will be heavily used.  
Instructor: Professor Massimo (Max) Fischetti  
Office: Marcus 201D  
Office Hours: TuTh 2:30-3:30 pm  
Teaching assistant: Yan Zhang. Office: Marcus 2. Office Hours: Tu Th 3:30-4:30 pm in Marcus 5

Textbook: B.G. Streetman and S. Banerjee, "*Solid State Electronic Devices*", (Prentice Hall, Upper Saddle River, NJ, 2006). Either the Fifth Edition (hard to find new, used copies are available) or the new Sixth Edition. Available at the Textbook Annex.

Advanced Reading: For chapter 1-5: C. Kittel, "*Introduction to Solid State Physics*", Fourth Edition (John Wiley and Sons, New York, 1971).  
For chapters 5-12: S. M. Sze, "*Physics of Semiconductor Devices*" (John Wiley and Sons, New York, 1981).  
For chapter 14: Andrew Grove, "*Physics and Technology of Semiconductor Devices*" (John Wiley and Sons, New York, 1967)...if you can find it, or Y. Taur and T. H. Ning, "*Fundamentals of Modern VLSI Devices*", (Cambridge University Press, New York, 1998)

Grading: Homework	15%	(6-to-8 assignments approximately every 2 weeks)
Midterm 1	20%	(week of October 12 on chapters 1-5)
Midterm 2	20%	(week of November 16 on chapters 6-10)
Final	35%	(week of December 14)
Class Participation	10%	

Purpose of the Course:

- Provide the basic foundations to understand the electronic and charge transport properties of semiconductors and semiconductor devices
- Explain the operating principles semiconductor devices
- Give an outline of the technology and material science needed to manufacture VLSI semiconductor devices

Outline:

1. Elements of Modern Physics and Quantum Mechanics: Electrons, atoms, molecules, bonds
2. Crystals: Structure, lattices, bases, reciprocal lattices
3. Energy Bands in Solids
4. Elements of Statistical Mechanics of Electrons and Holes in Semiconductors: Maxwell-Boltzmann and Fermi-Dirac statistics
5. Drift-Diffusion Model for Charge Transport in Solids
6. Generation and Recombination Processes
7. Junctions: p-n Junctions, Schottky Junctions, Heterojunctions
8. Field-Effect Transistors: JFET and MESFET
9. MOS Capacitors
10. MOSFETs
11. Bipolar Transistors
12. Optical and Heterojunction Devices
13. Quantum Effect Devices
14. Semiconductor Processing and Integrated Circuits