

# ESE 231: Introduction to Semiconductor Devices.

Spring 2008

Monday/Wednesday: 3<sup>50</sup> – 5<sup>10</sup> pm, Old. Chem. 138

**Course Description:** *This course provides the background in semiconductor physics and technology to equip electrical engineering student with necessary understanding of the operation and general design principles of semiconductor electronic devices. Concepts of energy bands, charge carrier transport and electron-hole generation-recombination are introduced. Junctions between metals and semiconductors as well as between semiconductors of different properties are studied. Operation principles and technology of the diodes and transistors with special emphasis on Field-Effect-Transistors are covered. Introduction into contemporary nano-scale semiconductor electronics is given.*

**Course Designation:** Required for EE

**Text Book:** Donald A. Neamen, “An introduction to semiconductor devices”, McGraw Hill, 1<sup>st</sup> ed., 2006, ISBN 0-07-298756-1

**Prerequisites:** AMS 161 or MAT 127 or 132 or 142 and PHY 127 or 132/134 or 142

**Corequisite:** None

**Instructor:** Leon Shterengas (631-632-9376, [leon@ece.sunysb.edu](mailto:leon@ece.sunysb.edu));  
Office hours: Thursday/Friday 9-11am, Light Engineering Bldg. 143

## Tentative lecture plan:

L01. Course overview. Integrated circuits. Components of the MOSFET.
L02. Electric field, charge, current, voltage, metals, isolators. Capacitor.
L03. Semiconductor crystals, energy bands, effective mass.
L04. Intrinsic and doped semiconductors.
L05. Charge carrier drift and diffusion.
L06. Electron-hole recombination and generation.
L07. Band diagrams. Ohmic and Schottky contacts.
<b>Midterm 1.</b>
L08. Field effect. MOS capacitor.
L09. P-n junction. P-n diode.
L10. Carrier transport through n-p-n structure.
L11. MOSFET operation.
L12. MOSFET input/output characteristics.
L13. MOSFET small signal parameters.
L14. CMOS technology.
L15. JFET and MESFET operation.
<b>Midterm 2.</b>
L16. MOSFET nonidealities.
L17. MOSFET scaling. Short channel devices.
L18. BJT structure and operation.
L19. BJT input/output characteristics. Fabrication of BJT.
L20. BJT nonidealities.
L21. BJT frequency limitations.
L22. Choice between MOSFET and BJT.
<b>Midterm 3.</b>
L23. Semiconductor heterojunctions. HBT.
L24. 2D charge carriers. HEMT.
L25. Course review. Exemplary problems consideration.
<b>Final Exam.</b>

**Grading: Homeworks 50%, Exams 50%**