

EC 471 Physics of Semiconductor Devices

2008/2009 Catalog Data:

Study Semiconductor Electronic Devices, including growth and structure of semiconductors, energy bands and charge carriers in semiconductors, junctions, diodes, bipolar junction transistors, field effect transistors and devices.

Course Schedule:

4 hours lecture and 1 hour discussion / Lab

Textbooks:

Semiconductor Devices-Physics and Technology, by S. M. Sze, 2nd Edition, John Wiley & Sons, Inc., 2002

Reference:

Solid State Electronic Devices, by Ben G. Steetman and Sanjay Banerjee 5th Edition, Prentice Hall, 2000

Semiconductor Device Fundamentals by Robert F. Pierret, Addison-Wesley Publishing, 1996

Semiconductor Physics and Devices by Donald A. Neamen, 3rd Edition, McGrawHill, 2003

Semiconductor Devices- Basic Principles by Jasprit Singh, John Wiley and Sons Inc., 2001

Coordinator:

Theodore D. Moustakas, Professor, ECE Department

Prerequisites by topic:

CAS PY 313: Waves and Modern Physics

or PY 354: Modern Physics

Goals:

To provide students with:

- A sound understanding of the basic Physics of Semiconductors.
- A thorough knowledge of the structure, operation and limitations of current day electronic and optical devices.
- The basic tools and the fundamental knowledge needed to understand the next generation of electronic devices.

Course Outcomes:

As an outcome of completing this course, students should be able to:

1. Master the basic properties of semiconductors including crystal growth and structure, band structure, carrier statistics, doping, carrier transport and recombination phenomena, thermionic emission, tunneling and high field effects.

2. Understand the basic fabrication steps and the principles of the operation of p-n junction, including current-voltage characteristics, charge storage and transient behavior, junction breakdown and heterojunctions.
3. Understand the basic principles of the operation of bipolar junction transistors, including frequency response, switching, heterojunction bipolar transistors, thyristors and other power devices.
4. Understand the fundamentals of MOSFET, including CMOS and MOS memory structures.
5. Understand metal-semiconductor contacts and their applications to MESFET and MODFET.
6. Understand the operation of basic photonic devices such as LEDs, Semiconductor laser,
Photo-detectors and solar cells
7. Learn of how to measure basic properties of semiconductors and devices, including conductivity, optical absorption, photoluminescence,
8. Learn of how to form and characterize metal semiconductor interfaces and p-n junctions.
9. Write reports on laboratory projects.
10. Learn how to collaborate in Laboratory experiments and the analysis of the measurements.
11. Improve communication skills through class participation
12. Understand the evolution and the importance to the society of the semiconductor technology.
13. Contribute in the discovery of new opto-electronic devices.
14. Apply math and basic science tools to solve engineering problems

Course Outcomes mapped to Program Outcomes:

| Program: | A | B | C | D | E | F | G | H | I | J | K |
|------------------|--------|------|---|------|------|----|------|-------|------|------|---------|
| Course: | 1-8,14 | 7-13 | 8 | 8-10 | 8-10 | 12 | 9,11 | 12,13 | 1-14 | 1-14 | 8-10,13 |
| Emphasis: | 5 | 4 | 2 | 3 | 3 | 3 | 4 | 3 | 4 | 5 | 4 |

Contribution of Course to Meeting the Professional Component:

Engineering topics: 60%

Math & Basic Science: 30%

General Education: 10%

Prepared by: Professor Theodore D. Moustakas

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