Course Description
ECE 4339 - Physical Principles of Solid State Devices

Required Course in all BSEE Degree Plans
Elective Course in BSCpE Degree Plan

2005 Catalog Data: ECE 4339: Physical Principles of Solid State Devices. Cr 3. (3-0) Prerequisites: ECE 3317, ECE 3455, and credit for or concurrent enrollment in ECE 4119. Electronics, modern physics, and electromagnetism used to develop fundamental understanding of bipolar, Schottky, and MOS solid state device operation.

Textbook: Ben G. Streetman and Sanjay Kumar Banerjee, "Solid State Electronic Devices" 6 ed., Pearson/Prentice Hall ISBN 0-13-149726-X

Course Coordinator: Leonard P. Trombetta, Associate Professor in Electrical and Computer Engineering.

Prerequisites by Topic:

1. Static and dynamic electromagnetic theory.
2. Calculus and differential equations.
3. Modern physics.
4. Basic chemistry.
5. Advanced electronics.

Schedule: This course meets 3 hours per week during a fall or spring semester, typically meeting twice a week for an hour and a half. There are typically 14 weeks of meeting time in a semester. It is frequently offered during the summer as well.

Expected Course Outcomes:

1. To give each student a solid knowledge-base in the fundamentals of mathematics and basic science. Solid state physics is used as a basis for semiconductor devices. Analyses of the operation of various devices requires mathematics thus strengthening students' knowledge from previous courses. (Program Course Outcome #1)

2. To give each student a solid knowledge-base in the fundamentals of electrical and computer engineering. This course provide the basic knowledge of semiconductor physics and Si devices. (Program Course Outcome #2)

3. To develop in each student the basic skills of problem solving and critical thinking. Homework and laboratory projects together with the class lectures, require the students to develop problem solving skills and critical thinking. (Program Course Outcome #3)

4. To impart to each student a sense of ethical and professional responsibility. The importance of professional and ethical responsibility is emphasized in the course and is enforced as the Academic Honesty Policy of the University, which applies to all assignments. (Program Course Outcome #8)

5. To give each student the type of real-world design experience that is crucial to the education of an engineer, including an appreciation for technical, economic, and social issues. Design issues are addressed in assignments focused on material properties in electronics. (Program Course Outcome #9)

6. To give each student knowledge of contemporary issues that relate to engineering. During the course lectures, issues related to the development of new devices and materials used in microelectronics are addressed. (Program Course Outcome #10)

Course Topics:

1. Semiconductor physics: crystal structure and its electronic properties (7.5 class hours)
2. Current carriers and transport (6 class hours)
3. P-N junction diodes (12 class hours)
4. Schottky diodes and metal-semiconductor contacts (4.5 class hours)
5. Bipolar transistors (8.5 class hours)
6. Junction field effect transistor (JFET) and insulated gate transistors (MOSFET). (6 class hours)
7. Integrated circuits (1.5 class hours)

Professional Component:

Math/Basic Science: 1.0 semester hour; Engineering Science: 1.0 semester hour; Engineering Design: 0.5 semester hour; General Education: 0.5 semester hour.

Prepared by:

Leonard P. Trombetta, Associate Professor in Electrical and Computer Engineering, May 19, 2008.