**EE 324  Physical Electronics**

**Designation:**  Required.

**Catalog Description:** Review of quantum mechanics fundamentals, H-atom, and chemical bonding. Introduction to band structure models and materials. Semiconductor doping, charge carrier statistics and charge transport, including ambipolar transport. Metal-semiconductor and PN junctions. DP

**Credits:**  3

**Pre--requisites:** MATH 243 Calculus III and PHYS 274 General Physics III; or consent.

**Class/Lab Schedule:**  3 lecture-hours per week. Exam review sessions as needed.

**Topics Covered:**
- 22. The Semiconductor Band Model -- key properties and features (6 hrs)
- 23. Carrier Statistics (2 hrs)
- 24. Charge Transport in Semiconductors. (4 hrs)
- 25. Ambipolar Transport in Semiconductors (6 hrs)
- 26. Semiconductor Junctions -- Introductory Physical Overview: Metal-semiconductor junctions (3 hrs), PN junctions & Design (4 hrs)
- 27. BJTs, FETs – Introductory overview & design features (3 hrs)
- 28. Course Summary (integrating all course components) (2 hrs)

**Textbook and Other Required Materials:**
“Semiconductor Physics and Devices”, 3rd Ed., by Donald Neaman

Reference Texts:
- “Physics of Semiconductor Devices” (2nd Ed.) by S. M. Sze
- “Semiconductor Device Fundamentals” by Robert F. Pierret
- “Physics of Semiconductor Devices” by Michael Shur

**Course Objectives and Relationship to Program Objectives:** The course objectives are directed to building an understanding of the semiconductor device materials and charge transport models supportive of understanding and designing current and emerging semiconductor IC devices. The introduction to semiconductor devices is provided in a format to support related subsequent design and analysis. Model command is a central objective in support of future design. [Program Objectives this course addresses: 1, 2, and 4.]

**Course Outcomes and Their Relationship to Program Outcomes:** The student shall acquire
- The ability to apply electron and hole carrier statistics to semiconductor devices. [1]
- A knowledge of the underlying quantum mechanics, statistical mechanics and charge transport physics models governing semiconductor materials and devices. [1, 3, 5, 9, 11]
- An understanding of the basic principles of semiconductor devices [1, 3, 9, 11]

**Contribution of Course to Meeting the Professional Component:** "Engineering topics:
Computer Usage: Mathematics software may be used to solve assigned problems.

Design Credits and Features: This course has no design credit, although approximately 5-10% of the homework and exam problems incorporate some design feature or issue. Design issues are pertinent to the latter part of the course.

Instructor(s): Dr. David Garmire, Dr. Aaron Ohta, Dr. Vinod Malhotra, Dr. Victor Lubecke, Dr. Olga Boric-Lubecke, Dr. James Holm-Kennedy

Person(s) Preparing Syllabus and Date: Dr. James Holm-Kennedy, 1/09/09.