COURSE: EECS 320. **TITLE:** Introduction to Semiconductor Devices. **PREREQUISITES:** Physics 240. **REQUIRED**

TEXTBOOK: R.F. Pierret, Semiconductor Device Fundamentals, Addison-Wesley

CATALOG DESCRIPTION: Introduction to semiconductors in terms of atomic bonding and electron energy bands. Equilibrium statistics of electrons and holes. Carrier dynamics; continuity, drift, and diffusion currents; generation and recombination processes, including important optical processes. Introduction to: PN junctions, metal-semiconductor junctions, light detectors and emitters, bipolar junction transistors, junction and MOSFETs.

COURSE OBJECTIVES:

1. To teach students fundamental concepts in semiconductor physics;
2. To teach students the current-voltage relationships of diodes and transistors based on the electronic properties of semiconductors and drift and diffusion transport mechanisms;
3. To teach students how to analyze and design diode and transistor devices based on semiconductor doping, semiconductor material properties, and device geometry;
4. To prepare students for follow-up courses in the Solid-State and Circuits areas of the EE program.

COURSE OUTCOMES [Program Outcomes Addressed]

1. Ability to analyze semiconductor electronic properties based on energy band structure; [1]
2. Ability to compute electron and hole concentrations and Fermi level in semiconductors; [1]
3. Ability to compute spatial and temporal dependence of electron and hole concentration based on diffusion, generation, and recombination processes; [1,13]
4. Ability to construct energy band diagrams for semiconductor structures and devices; [1]
5. Ability to analyze and design I-V and C-V characteristics of junction diodes; [1,11,13]
6. Ability to analyze and design I-V characteristics of BJTs and MOSFETs; [1,11,13]
7. Ability to analyze basic amplifier and switching circuits based on transistors. [1,11,13]

PROGRAM OUTCOMES ADDRESSED: 1,11
PROFESSIONAL COMPONENT ADDRESSED: 13
PREPARED BY: A.E.Yagle & J.D. Phillips on Jan. 4, 2005

CLASS/LABORATORY SCHEDULE:
LECTURES: 3 per week @ 50 minutes
RECITATION: 1 per week @ 1 hour

TOPICS COVERED:

1. Band theory and semiconductors
2. Electrons and holes
3. Fermi and carrier statistics
4. Intrinsic & doped semiconductors
5. Drift and diffusion transport
6. P-n junction diode theory
7. Optoelectronic diodes
8. Metal-semiconductor contacts
9. Bipolar junction transistors
10. MOS capacitors
11. Field effect transistors

ASSESSMENT (Course outcomes)

1. 10 problem sets [1,2,3,4,5,6]
2. 3 closed-book exams [1,2,3,4,5,6]

COURSE DESCRIPTION: University of Michigan, College of Engineering, ELECTRICAL ENGINEERING PROGRAM