

ESM 336 Electronic Materials (Required)

Course Catalog description:

Solutions of time-dependent non-equilibrium carrier distributions, with applications to optoelectronics and transistors. Doping of semiconductors and IC fabrication technology. Vacuum tube device operation, amplifiers and logic circuits. JFET and MOSFET principles of operation. Implementation of Boolean logic, NAND-only and NOR-only logic. Floating-gate memory. CCDs.

3 credits

Pre- or Corequisite(s): ESG 333 Materials Science II: Electronic Properties

Text(s) or other required material: J.R. R. Hook, H. E. Hall, Solid State Physics, 2nd Ed., 1993, Wiley, ISBN: 0471928054

Course learning outcomes: The purpose of the course is a detailed physical understanding of the basic semiconductor devices used for modern electronic technology (diodes, transistors, amplifiers, logic gates, memories), as well as an understanding of the materials and processes used to manufacture these devices.

Topics Covered:

Week 1-2. Equation of Continuity, Time-dependent Non-equilibrium Distributions, Dielectric Response

Week 2. Photoconductivity, LEDs

Week 3-4 Doping Methods-Atomic Diffusion and Ion Implantation

Week 5. Vacuum Tube Devices, Diode and Triode, Applications

Week 6. Junction Field Effect Transistors

Week 7. Ideal MOS Capacitor

Week 8. MOSFETs, Principle of Operation, Amplifier Circuit

Week 8. SRAM and DRAM Memory

Week 9-10. MOSFET Logic, CMOS NAND and NOR

Week 11-12. Fabrication

Week 13. Floating-gate MOS Memories, CCD Devices

Class/ Laboratory Schedule:

ESM	336	Electronic Materials	LEC	1	TUTH	2:20 PM	3:40 PM
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Contribution of Course to meet requirement of Criterion 5: The course involves applying the basic theory learned in the first course (ESG 333) to specific semiconductor devices-transistors, optoelectronics, memory devices. Both device operation and manufacture are covered and the student is exposed to the various challenges in materials science that are required to advance past the current technology (new materials, improved crystal perfection, limits of lithographic techniques, intrinsic limits on device size, cooling problems, electron velocity saturation). Discussions of these issues is aimed at getting the students to think of possible solutions and applications.

Relationship of course to program outcomes: see table

Person(s) who prepared this description and date of preparation: Jonathan Sokolov, 6/28/09