

ECE 520.485
Advanced Semiconductor devices.

This course is designed to develop and enhance the understanding of the operating principles and performance characteristics of the modern semiconductor devices beyond simple FET and Bipolar devices studied in the Integrated Electronics, although the physical basics of their operation are reviewed.

The emphasis is on device physics and fabrication technology. III-V, SiGe and SiC technologies are studied. The devices include modern short-channel CMOS technology, heterostructure FET's, MESFET's, , Si-Ge technology, heterostructure bipolar devices, microwave devices, tunneling diodes and transistors, transferred electron devices and transit time diodes.

Credits: 3

Textbooks:

Main:

D. Neamen,

Semiconductor Physics and Devices Mc Grow Hill

Recommended:

S. M. Sze,

Semiconductor Devices, Physics and Technology J. Wiley and Sons

Ben G. Streetman,

Solid State Electronic Devices, Prentice Hill

Jasprit Singh

Semiconductor Physics and Devices Wiley

Course objectives:

The objective of this course is to familiarize the students with the state-of-the-art semiconductor electronic devices. This includes understanding the underlying physical principles, design and fabrication methods, performance characterization, and major limitations of the devices. Both Silicon and III-V devices are studied.

Course Syllabus and Schedule

WEEK 1

Introduction. What are the devices are supposed to do and what makes a device useful. Vacuum devices.

WEEK 2

Review of Semiconductor Basics

WEEK 3

Transport in semiconductors

WEEK 4

P-N junction in equilibrium. P-N junction under bias. P-N junction diode. Fabrication of junctions

WEEK 5

Metal-semiconductor contact. Schottky diode. Ohmic contacts.

WEEK 6

Physics and fabrication of heterojunctions.

WEEK 7

Bipolar junction transistors. Frequency characteristics.

WEEK 8

Heterostructure bipolar transistor (HBT). Si-Ge technology.

MIDTERM (Take Home)

WEEK 9

MOS Junction under bias. MOSFET below and above threshold.

WEEK 10

Short channel effects in MOSFET. MESFET's

WEEK 11

High mobility transistors –HEMT and Pseudomorphic HEMT.

WEEK 12

Negative differential resistance devices. Tunneling.

WEEK 13

Microwave devices: Transferred electron devices (Gunn diode), IMPATT, TRAPATT,

WEEK 14

Quantum Confinement: quantum wells, wires, dots

WEEK 15

Resonant tunneling devices

WEEK 16

Student Seminars !!!!

FINAL (Take home)