Course Syllabus

EEMF 6321 — Active Semiconductor Devices
Spring 2016

Professor Contact Information
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Course Pre-requisites, Co-requisites, and/or Other Restrictions

Pre-requisite: *EEMF 6319 Quantum Physical Electronics*, or demonstrated knowledge of the following:

Requisite Knowledge:

Calculus-based undergraduate Physics: Mechanics and Electricity & Magnetism
Engineering Electromagnetic theory
Semiconductor physics, including:
- Energy-band theory
- Carrier distribution in equilibrium

Recommended Co-requisite: *EE6320 Fundamentals of Semiconductors*

Course Description

The physics of operation of active devices will be examined, including bipolar junction transistors and field-effect transistors: MOSFETs, JFETS, and MESFETS. Special-purpose MOS devices including memories and imagers will be presented.

Student Learning Objectives/Outcomes

This course is designed to provide a detailed understanding of active semiconductor devices, how they function, how different devices are related, and how their properties are likely to evolve in the future. Specific learning objectives include:
1. Understand and be able to evaluate idealized models of the Bipolar Junction Transistor (BJT) and the effects of non-idealities such as base-width modulation.
2. Understand the general properties and limitations of gradual-channel Field-Effect Transistor (FET) models.
3. Demonstrate the ability to evaluate electrical properties of the MOS structure and gradual-channel models of the Junction FET (JFET) and Metal-Oxide-Semiconductor FET (MOSFET), and understand the consequences of reducing the dimensions of these devices.
4. Understand the principles of operation of spontaneously oscillating diodes: negative resistance and transit time devices.
5. Understand the principles of operation of simple optoelectronic devices: optical sources and detectors.

Required Textbooks and Materials

William R. Frensley, *Understanding Electron Devices* (an electronic work in progress, can be downloaded at:
http://www.utdallas.edu/~frensley/UndElDev/download/
(This web site is password protected. Access codes will be given out in class.)
Also, please note the difference in this font between the letter l and the numeral 1.

Other required resources will be handed out in class.

Course Outline

1) Review of Fundamentals
   a) Equilibrium carrier distribution
   b) Self-consistency and screening
   c) Drift-diffusion transport and current continuity
   d) Current flow across Schottky barriers and PN junctions.
2) Bipolar Junction Transistors
   a) I(V) characteristics
   b) Device models
3) Junction Field-Effect Transistors
   a) □ Junction FETs (JFETs)
   b) □ Metal-Semiconductor FETs (MeSFETs)□
4) Metal-Oxide-Semiconductor FETs
   a) □ MOS interface behavior
   b) □ Ideal characteristics
   c) □ Advanced MOS topics
      i) Interface physics
      ii) Characterization
      iii) Non-idealities
   d) □ Specialized devices
      i) MOS memories
5) A historical technology: vacuum tubes
6) Transistor systematics: BJT and FET are limits of a single device continuum.□
7) Microwave devices
   a) □ Tunnel diode
   b) □ Gunn effect
   c) □ IMPATT
8) Optical devices
   a) □Sources
   b) □Detectors

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Exams

There will be a midterm exam in March.
There will be a final examination at the time designated by the University.

Grading Policy

Scoring coefficients:

Homework	25%
Mid-term exam	25%
Final exam	50%

Course & Instructor Policies

Assignments and exams are due at the specified times. If employment, illness, or personal obligations create conflicts, please see me well before the due dates.

Off-campus Instruction and Course Activities

None.

Comet Creed

This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

"As a Comet, I pledge honesty, integrity, and service in all that I do."

UT Dallas Syllabus Policies and Procedures

The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus.

Please go to http://go.utdallas.edu/syllabus-policies for these policies.

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.