Introduction to Electronic Devices
(Course Number 300331) Fall 2006

Syllabus
Dr. Dietmar Knipp
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Information:
http://www.faculty.iubremen.de/dknipp/

Critical dimension (m)

Ref.: IBM

Ref.: Apple

Ref.: Palo Alto Research Center
Introduction to Electronic Devices

(Course Number 300331 )
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Introduction to Electronic Devices

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Scheduling of the Course
Fall 2006

Easthall, Room 5
Monday 08:15 to 9:30
Wednesday 14:15 to 15:45
Introduction to Electronic Devices

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Specialization course for 3rd year undergraduate students in Electrical Engineering and Computer Science (EECS), Electrical and Computer Engineering (ECE) and Computer Science (CS)

The course is open for graduate students in Electrical Engineering (Communications, Systems and Electronics), Smart Systems, and Nanomolecular Science

The course accounts for 4.5 ECTS credit points
Introduction to Electronic Devices

Fall 2006

Composition of the final grade:

**Homework:** 18%
6 Homework assignments 3% each

**Midterm:** 30%
Duration: 1 hour
Utilities: Formula sheet

**Final Exam:** 52%
Duration: 2 hour
Utilities: Formula sheet
The complete semester will be covered.
Introduction to Electronic Devices

Course modules and Syllabus

Introduction to Course (1 lecture)
1. Introduction to Electronic Devices (1 lecture)
2. Fundamentals of Semiconductors (5 lectures + 1 HW)
3. Electronic Transport (3 lectures + 1 HW)
4. Diodes (4 lectures + 1 HW)

Midterm (1 session)
5. Bipolar transistors (3 lectures + 1 HW)
6. Metal-Oxide-Semiconductor Field-Effect-Transistor (5 lectures + 1 HW)
7. Digital Circuits (2 lecture + 1 HW)
Course topics and Syllabus

0. Introduction to Electronic Devices

This module will give an introduction in the area of electronic devices. Electronic devices are of major importance for applications in information technology, consumer electronics and communications, healthcare, life sciences, optical sensing, lighting, energy and manufacturing.

An historical introduction in the field of electronics will be given starting with the invention of the bipolar transistor by Shockley, Battain and Bardeen. The evolution of electronics will be discussed. The introductory session will end with an outlook presenting different areas of electronic device research.

1. Fundamentals of Semiconductors

The operation principle of electronic devices cannot be understood without introducing the fundamentals of semiconductors. Throughout this module the properties of electronic materials will be introduced like the structural properties of materials, the band structure and doping of semiconductors.
Course topics and Syllabus

2. Electronic Transport

The energy bands in semiconductors will be introduced, so that the transport of carriers in these bands can be discussed. Finally, the fundamental semiconductor equations will be explain and generation and recombination processes will be discussed.

3. Diodes

Diodes are the most fundamental electronic device. The operating principle of silicon pn junction diodes will be covered throughout this module. Starting from the fundamentals semiconductor properties the diode equation will be derived and different applications will be discussed. Furthermore, the behavior of metal/semiconductor contacts (Ohmic contacts and Schottky diodes) will be discussed.
4. Bipolar Transistors

The Bipolar transistor is the second device out of the family of bipolar devices, which will be covered throughout the course (the diode is the first bipolar device). The operating principle of npn and pnp bipolar transistors will be discussed and the transistor equations will be derived. Several examples will be discussed how to design and optimize bipolar transistors for different applications.

5. Metal-Oxide-Semiconductor Field Effect Transistor

The metal-oxide-semiconductor field-effect-transistor (MOSFET) is the most important electronic device in semiconductor industry. Almost 95% of all electronic products (e.g. microprocessors and memory devices) are based on MOSFETs and CMOS (Complementary metal oxide semiconductor) technology. The operating principle will be explained and the advantages of CMOS technology will be discussed.
Course topics and Syllabus

6. Digital Circuits

This final part of the lecture is concerning with CMOS based digital circuits. CMOS technology is by far the most popular technology for the implementation of digital electronics. The idea of CMOS technology will be introduced and the operating principle of basic digital circuits like CMOS inverters and pass-transistor logic will be explained.
References


