Politecnico di Torino

Academic Year 2010/11 (first time established in A.Y.2007/08)

02LTHJA

Electronic devices

1st degree and Bachelor-level of the Bologna process in Electronic And Computer Engineering - Vercelli (III FACOLTA' DI INGEGNERIA)

Teacher	Status	SSD	Les	Ex	Lab	Years Stability
Goano Michele	AC	ING-INF/01	4	2	0	3

SSD	CFU	Activities	Area context
ING-INF/01	6	B - Caratterizzanti	Ingegneria elettronica

Objectives of the course

Electronic Devices is the first course of electronics in the ECE curriculum. Its goal is to introduce the students to the operating principles of the most common semiconductor devices: junction diodes, bipolar transistors and field-effect transistors, including their small-signal models and elementary examples of amplifiers. An introduction to the fundamentals of semiconductor technology is also presented.

Expected skills

The course allows the students to acquire several among the basic skills of an electronic engineer, i.e., the ability to understand (and to compute in some important cases) the band diagram of a semiconductor device; the understanding of the operating principles of junction diodes, bipolar transistors and MOSFETs; the ability to compute the parameters of their large-signal models; the ability to compute the DC bias point of a nonlinear device, to determine a small-signal model by forming linear approximations about the DC bias point, and to use the small-signal model in the study of simple one-stage amplifiers. The students will be introduced also to the basics of non-volatile memories and RAM architectures.

Prerequisites

The prerequisites for understanding the physical models of electronic devices are calculus (up to and including linear differential equations) and the first-year courses in physics. The study of large- and small-signal models requires the fundamentals of circuit theory.

Syllabus

Introduction to the physics of semiconductor materials: semiconductors in equilibrium, charge transport and generation-recombination mechanisms, determination of band diagrams, the drift-diffusion model.
Semiconductor diodes: operating principles, forward and reverse bias, large- and small-signal models, breakdown mechanisms, circuit applications.
Bipolar junction transistors (BJTs): operating principles, modes of operation, large-signal models, DC bias and small-signal equivalent circuits.
Operating principles of field-effect transistors (FETs). Metal-oxide-semiconductor (MOS) structures. MOSFETs: large- and small-signal models, switching and linear applications. MOS scaling, fundamental CMOS logic gates.
Introduction to solid-state memory: ROM and PROM, non-volatile rewritable memory, static and dynamic RAM.
Basics of device fabrication technology: growth of semiconductor materials, doping by diffusion and ion implantation, oxidation, photolitography, etching, bonding, CMOS technology.

Laboratories and/or exercises

Lessons will be followed by numerical examples and exercises.

Bibliography

For each argument, references will be given during the course.

Revisions / Exam

The exam includes a written text and an oral discussion.

Programma definitivo per l'A.A.2010/11

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