COMMUNICATION ENGINEERING AND ELECTRONIC TECHNOLOGIES

(Lecce - Università degli Studi)

Teaching ELECTRONIC AND PHOTONIC DEVICES

GenCod A004878

Owner professor Massimo DE VITTORIO

Teaching in italian ELECTRONIC AND PHOTONIC DEVICES

Teaching ELECTRONIC AND PHOTONIC DEVICES

SSD code ING-INF/01

Reference course COMMUNICATION ENGINEERING AND ELECTRONIC

Course type Laurea Magistrale

Credits 6.0

Teaching hours Front activity hours: 54.0

For enrolled in 2019/2020

Taught in 2019/2020

Course year 1

Language ENGLISH

Curriculum PERCORSO COMUNE

Location Lecce

Semester First Semester

Exam type Oral

Assessment Final grade

Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

The course deals with the working principle of the most important electronic devices (diodes, bipolar junction transistor, CMOS technology ...) and photonic devices (LED, Laser, optical fibers, photovoltaic devices ...).
It is organized in the following parts:

- Introduction on the solid state physics, energy bands and current transport mechanisms in semiconductors.
- Two terminal and three terminal electronic devices (p-n and Schottky junction diodes, bipolar transistors and MOSFETs
- light emitting and detecting photonic devices

The course also includes lectures on simulation of devices behavior.

REQUIREMENTS

Background on solid state physics is recommended

COURSE AIMS

Knowledge and understanding. Students must have a background in electromagnetic fields and waves and basic background in material science:

- the students must have the basic cognitive tools to understand semiconductor crystals and their electronic properties and apply this to understand how electrons move and distribute in a semiconductor device;
- they must have a solid knowledge of the electromagnetic waves and fields;
- they must be able to understand electric fields, potentials and voltages and electrostatic properties of materials;
- They must have a basic knowledge of electronic circuits, passive and active two- and three-terminals electronic devices.

Applying knowledge and understanding. After the course the student should be able to:

- understand what are the carrier transport, absorption and recombination mechanisms in semiconductor devices;
- understand how an electronic device works and what are the key parameters to design an efficient two terminal or three terminal electronic devices;
- design a LED or Laser device for different photonic applications;
- understand and design a photodetector.

Making judgements. Students are guided to learn critically everything that is explained to them in class, to understand the behavior of the state of the art technologies for electronic and photonic devices and to design new devices.

Communication. The students will be stimulated to be able to communicate with a varied and composite audience, not culturally homogeneous, in a clear, logical and effective way, using the methodological tools acquired and their scientific knowledge and, in particular, with and professional and scientific vocabulary.

Learning skills. Students must acquire the critical ability to understand the behavior of devices at the nanoscale. They should be able to develop and apply independently the knowledge and methods learnt with a view to possible continuation of studies at higher (doctoral) level or in the broader perspective of cultural and professional self-improvement of lifelong learning.

TEACHING METHODOLOGY

The teaching of the course will make use of both the blackboard and projection of videos and slides. Simulation of devices will be also done by exploiting freely available online tools.

ASSESSMENT TYPE

Oral exam. The student is asked theoretical questions on each part of the course. During the discussion the student is asked to elaborate on the purpose of specific technological solutions in the design and fabrication of electronic devices and he/she is also asked to propose a different solution for a device with specific properties.

FULL SYLLABUS	*Solid State Physics* Physics of semiconductor materials, semiconductor technology, metal-semiconductor junction, p-n junction (12 hours). *Semiconductor Electronic devices* The Bipolar Junction Transistor (BJT), BJT working principle, BJT static and dynamic I-V characteristics, Models for BJT, The MOS Transistors and system, current-voltage characteristics of a MOSFET, MOSFET small and large signal models (22 hours). *Photonic devices* Optical processes in semiconductors, the LED, the LASER, laser waveguide and resonant cavities, material gain, type of semiconductor lasers, optical detectors and photovoltaic devices (20 hours).
REFERENCE TEXT BOOKS	[1] lecture notes [2] S.M. Sze, Semiconductor Devices: Physics and Technology, Bell Tel.Labs.Inc. [3] R.S. Muller-T.I. Kamins, Dispositivi Elettronici nei Circuiti Integrati, Boringhieri [4] Ghione G., Dispositivi per la Microelettronica, McGraw Hill.