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

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SSD code ING-INF/01

Reference course COMMUNICATION ENGINEERING AND ELECTRONIC

Course type Laurea Magistrale

Credits 6.0

Teaching hours Ore-Attivita-frontale: 54.0

For enrolled in 2020/2021

Taught in 2020/2021

Course year 1

Language INGLESE

Curriculum PERCORSO COMUNE

Location Lecce

Semester Primo-Semestre

Exam type Orale

Assessment Voto-Finale

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

BRIEF COURSE DESCRIPTION

The course deals with the most advanced technologies at the nanometer and micrometer scale for the fabrication and characterization of electronic, photonic and micro- and nano-electromechanical MEMS/NEMS systems and devices. It describes how micro and nanotechnologies impact different fields and applications such as Information and Communication Technologies (ICT), Energy, Lifescience and Medicine and it shows how the most advanced devices, often employed in our portable and home electronics, such as nanoscale transistors, smart sensors and microelectromechanical systems, are fabricated and tested. During the course several visits to the nanotechnology laboratory of the "Center for Biomolecular Nanotechnologies" of the Istituto Italiano di Tecnologia, with demonstrations of the available state of the art equipment for front-end (material and device fabrication) and back-end (device packaging, characterization, test) tools, will be done. The course also includes a training on multiphysics finite element method softwares for electronic, photonic and MEMS device design and simulation.

REQUIREMENTS

Background on solid state physics and semiconductor devices is recommended but not mandatory

COURSE AIMS

Knowledge and understanding. Students must have a background in semiconductor crystals and devices and basic background in material science:

- the students must have the basic cognitive tools to understand semiconductor crystals and their technology;
- they must have knowledge of the electromagnetic waves and how they are applied to microscopy and technology;
- they must be able to understand the chemistry behind micro and nanotechnologies;

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

- understand how a micro and nanodevice is designed, fabricated and tested;
- how micro and nano fabrication, characterization and packaging tools work;
- use simulation software tools to design and predict the operation of an electronic, photonic and microelectromechanical devices and systems;

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 and MEMS 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. In particular they will be asked to select a state of the art technology, recently proposed in high impact journals, and to make a presentation about it to the classroom.

Learning skills

Students must acquire the critical ability to understand the behavior of devices at the micro and 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 be a combination of projection of videos and slides and visits to labs with demonstration of state of the art technologies and clean-room equipments.

ASSESSMENT TYPE

Oral exam. Discussion on a state of the art nanotechnology for the fabrication of an electronic, photonic or microelectromechanical device.

FULL SYLLABUS

Introduction to Nanotechnology.

The nanoworld: top-down and bottom-up approaches for nanofabrication (4 hours);

Surface and Bulk Micro and Nanomachining: micro and nanotechnologies: electron beam lithography, scanning probe nanolithography, DUV and EUV lithography, X-Ray lithography, wet and dry etching, deposition and growth techniques, 3D laser lithographies, deep etching, LIGA (15 hours).

Characterization techniques

Electronic microscopy, scanning probe microscopy, microanalisis, spectroscopy (10 hours);

Applications of Nanotechnologies: examples of applications of nanotechnologies to electronic, photonic and micro and nanoelectromechanical devices and systems (4 hours);

Device simulation

Finite element (FEM) multiphysics modeling of an electronic, photonic and NEMS/MEMS device or structures (6 hours);

Laboratories

Laboratories on lithography, nanofabrication and characterization of nanostructures and devices (15 hours):

- Visit of clean room and observation of the operation of nanotechnological tools;
- Microscopy and characterization of samples and devices with different characterization tools.

REFERENCE TEXT BOOKS

[1] Handouts and course notes.

[2] Springer Handbook of Nanotechnology.