UE Advanced semiconductor devices

Level
Baccalaureate +5

ECTS
3 credits

Component
UFR PhITEM (physique, ingénierie, terre, environnement, mécanique)

Semester
Automne

- **Teaching language(s):** English
- **Open to exchange students:** Yes
- **Code d'export Apogée:** PAX9NPAK

Presentation

Description

The first part will give an overview of semiconductor devices trends and evolutions for calculations. Limits of traditional architectures as transistors and memories will be studied. Then we will described emerging solutions for calculations and memories including devices and architectures for advanced computing and artificial intelligence. The second part will address the physics of light emitting diodes.

Part I Semiconductor devices trends and evolutions for calculation

I.1 Moore's law limits and solutions
- MOSFET nano-transistors basics
- Static and dynamic power
- New architectures (Finfet, Nanowires)
- Dynamic power regulation
- Variability at ultimate scaling

I.2 Memories
- Volatile memories
- DRAM
- SRAM
- Non-volatile memories : Flash memories

I.3 Emerging non-volatile memories
- Resistive random access memories (OxRAM, CBRAM, PCRAM)

Crossbar and 3D architectures
Magnetic random access memories and spintronics
I.4 3D Technologies for heterogeneous integration
2D integration limitations
Parallel 3D
Sequential 3D
Applications to advanced calculations, smart imagers, photonics.
I.5 From CMOS to single electron devices
New phenomena at ultimate scaling
Low temperature electronics
Single electron transistor
Toward (single) spin electronics and quantum calculations
I.6 Emerging computing paradigms for AI
Some basics of neuromorphic computing
Convolutional neuronal networks
Spiking neurones using resistive memories
Fading the limits been memory and calculation.

Part II Light emitting diodes: Physics and devices

II.1 Fundamentals of radiative recombination in semiconductors.
II.2 Homojunction vs heterojunction Light emitting diodes.
II.3 Light emitting diode materials: growth and fabrication techniques.
II.4 Light emitting diode efficiency (injection, extraction).
II.5 Specificity of III-nitride Light emitting diodes (e.g. internal electric field, disorder).

Course parts

UE Advanced semiconductor devices - CMTD	Lectures (CM) & Teaching Unit (UE)	18h
UE Advanced semiconductor devices - TP	Practical work (TP)	8h

Recommended prerequisites

For part I: from M1: Basic principles (documents can be provided)
Diode, MOS Capacitance , MOSFET, Electronic transport in a semiconductor and in and oxide.

for part II: p-n junction, electronic structures, quantum wells.

Period : Semester 9

Useful info

Campus

- Grenoble - University campus