

EE-517

Bio-nano-chip design

Carrara Sandro

Cursus	Sem.	Type
Data and Internet of Things minor	H	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	3 weekly
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

Introduction to heterogeneous integration for Nano-Bio-CMOS sensors on Chip. Understanding and designing of active Bio/CMOS interfaces powered by nanostructures.

Content

Currents and capacitive-effects in water solutions
 Introduction to biological molecules
 Thermodynamics of molecular Interactions
 Nanotechnology for molecular assembly on chip' surfaces
 Nanotechnology to prevent electron transfer
 Nanotechnology to enhance electron transfer
 Chip design for electrochemical sensing: basic configurations
 Chip design for biosensing with label-free capacitance mode (CBCM & FTCC Methods)
 Chip design for biosensing in constant-bias (Current-to-Voltage & FTCC Methods)
 Chip design for biosensing in voltage-scan (VDCM & DDSM Methods)

Keywords

OpAmp, CMOS, biosensors, carbon nanotubes, alkane/silane thiols, proteins, DNA

Learning Prerequisites**Recommended courses**

Electronics I (BS course)
 General chemistry OR Chemistry of surfaces (both BS courses)
 Analysis IV (BS course)

Learning Outcomes

By the end of the course, the student must be able to:

- Choose bio materials
- Choose nano materials
- Judge an electrical interface
- Design complex analog circuits for electrochemical biosensing
- Design Bio-Nano-CMOS-sensing devices at system level
- Realize and discuss nanotechnology and molecular layers on chip Investigate
- Discuss biotechnology to Realize biosensors on chip

Teaching methods

Ex cathedra, and exercises

Assessment methods

Written

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Bibliography

1. Course slides
2. Book: S.Carrara, **Bio/CMOS Interfaces and Co-Design**, Springer, NY, 2013

Ressources en bibliothèque

- [Bio/CMOS Interfaces and Co-Design / Carrara](#)

Websites

- <http://people.epfl.ch/cgi-bin/people?id=182237&op=bio&lang=en&cvlang=en>