EE-519

Bioelectronics and biomedical microelectronics

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Cursus	Sem.	Type
Biomedical technologies minor	H	Opt.
Data and Internet of Things minor	H	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.
Neuro-X minor	H	Opt.
Neuro-X	MA1, MA3	Opt.

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

Summary

The course covers the fundaments of bioelectronics and integrated microelectronics for biomedical and implantable systems. Issues and trade-offs at the circuit and systems levels of invasive microelectronic systems as well as their eluding designs, methods and classical implementations are discussed

Content

Bioelectricity and bio-signals biopotentials, definition of selected bio-signals
Electrodes types of electrodes and integrated electrodes, characteristics and impact on the recording/driving circuits,neuron-semiconductor interface
Bio-signal recording low-noise amplifiers, architectures analysis, presentation of main design issues, low-powerlow-noise design techniques
Multichannel recording massively parallel recording techniques, examples of the cortical implants,compressed-sensing techniques
Electrical stimulation integrated circuits for electrical stimulation of tissues, specific issues related to operating voltage,charge balancing
In-vitro systems techniques for integrated recording in-vitro, stimulation
Neuromorphic integrated electronics usage of microelectronics to mimic neurons or higher-level functions,fundaments of microelectronic bio-inspired systems and applications in processing and vision
Application examples case studies of classical implanted systems, as well as prospective systems, including cochlearimplants, sight restoring retina implants, deep-brain stimulation systems, cortical recording systems (invasive), epilepsymanagement systems, bio-pills, multimodal systems

Keywords

Bio-electronics, bio-medical electronics, implantable microelectronic

Learning Prerequisites

Required courses

Electronics (fundaments, circuits and systems)

Learning Outcomes

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

- Elaborate design strategies and methods
- Elaborate specifications
- Analyze block level requirements
- Develop blocks, models

- Assess / Evaluate alternate existing method

Transversal skills

- Communicate effectively with professionals from other disciplines.
- Access and evaluate appropriate sources of information.
- Make an oral presentation.
- Write a literature review which assesses the state of the art.

Teaching methods

Ex cathedra and practical exercises, seminars

Expected student activities

Attend class lectures, solve exercises, study professional litterature and prepare a short report and short seminar on a selected topic

Assessment methods

Mandatory continusous control: written midterm
Mandatory continuous control: seminar and report
Mandatory final written examination

Resources

Bibliography

Will be reported in class

Moodle Link

- https://go.epfl.ch/EE-519

Prerequisite for

Diploma projects