

EE-519

**Bioelectronics and biomedical microelectronics**

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA1, MA3	Opt.

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

**Summary**

The course covers the fundamentals 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-power/low-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, fundamentals 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 cochlear implants, sight restoring retina implants, deep-brain stimulation systems, cortical recording systems (invasive), epilepsy management systems, bio-pills, multimodal systems

**Keywords**

Bio-electronics, bio-medical electronics, implantable microelectronic

**Learning Prerequisites****Required courses**

Electronics (fundamentals, circuits and systems)

**Learning Outcomes**

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

- Elaborate design strategies and method
- 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 literature and prepare a short report and short seminar on a selected topic

### Assessment methods

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

### Supervision

Office hours	No
Assistants	Yes
Forum	No

### Resources

#### Bibliography

Will be reported in class

#### Moodle Link

- <http://moodle.epfl.ch/course/view.php?id=1453>

### Prerequisite for

Diploma projects