

EE-519

Bioelectronics and biomedical microelectronics

Schmid Alexandre

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

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| 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

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

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| 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