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 examina
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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