EE-511

Sensors in medical instrumentation

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Cursus	Sem.	Type
Bioengineering	MA2, MA4	Opt.
Biomedical technologies minor	E	Opt.
Computer science	MA2, MA4	Opt.
Cybersecurity	MA2, MA4	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Robotics	MA2, MA4	Opt.
SC master EPFL	MA2, MA4	Opt.
Sciences du vivant	MA2, MA4	Opt.

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

Summary

Fundamental principles and methods used for physiological signal conditioning. Resistive, capacitive, inductive, piezoelectric and optical techniques used to detect and convert physiological information's to electrical signals. Laboratory and ambulatory devices for monitoring and therapy.

Content

1. **Physiological Mesurands**
Biopotentials; bioimpedance; mechanical, acoustic and thermal signals
2. **Noise in medical instrumentation**
Source and nature of the noise; noise reduction; instrumentation amplifier for biopotential measurement
3. **Biopotential measurement**
Electrodes; ECG, EMG and EEG measurement
4. **Resistive sensors**
Thermistor and its biomedical applications; strain gage for the measurement of blood pressure; force and accelerations of the body
5. **Inductive sensors**
Simple and mutual inductance and its medical applications
6. **Capacitive sensors**
Respiratory flow measurement by the gradient of pressure
7. **Piezoelectric sensors**
Force platform, accelerometer, angular rate sensor for the measurement of tremors and body movements, ultrasound transducer : measurement of pressure and flow rate
8. **Optical sensors**
Photoplethysmography; pulsed oxymetry
9. **Example of applications**

Keywords

sensors, instrumentation, biomedical devices, physiological measurement, monitoring

Learning Prerequisites

Required courses

courses en electrical circuit, basic electronics

Recommended courses

measuring systems or electronics or sensors

Important concepts to start the course

basic electronics, basic physics

Learning Outcomes

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

- Choose techniques detecting and convert physiological information's to electrical signals
- Exploit fundamental principles and methods used for physiological signal conditioning
- Design measuring devices
- Interpret error, noise in biomedical measuring systems

Transversal skills

- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.

Teaching methods

Ex cathedra, with exercises

Expected student activities

home work, short quizzes during semester

Assessment methods

Written

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

Medical Instrumentation : Application and design, JG Webster

Ressources en bibliothèque

- Medical Instrumentation / Webster

Notes/Handbook

Slides copies (to be completed during the lectures)
Polycopies (in French only)

Moodle Link

- http://moodle.epfl.ch/course/view.php?id=2571

Prerequisite for

Semester project and Master project