MICRO-624

Wearables and implantables for personalized and preventive healthcare

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Cursus	Sem.	Type
Microsystems and Microelectronics		Opt.

Language of teaching	English
Credits	2
Session	
Exam	Written
Workload	60h
Hours	**28**
Lecture	28
Number of positions	

Frequency

Every year

Remark

February 8 to 12, 2021

Summary

This multidisciplinary course presents, from both engineering and medical perspectives, the state-of-the-art, applications and impact of wearable and implantable technologies, with focus on cardiovascular healthcare shift from intervention-based to personalized and preventive medical strategies.

Content

The course will be organized in two main interactive parts, going from technology to medical and life style applications:
Part I (14 hours): Wearable and implantable technologies:
- Edge of the cloud sensing and computing and Internet of Humans
- Physical and physiological biosensors:
• Motion sensors: accelerometers, magnetometers, gyroscopes (focus on low power MEMS solutions)
• Biosignals and biosensors: ECG, EEG, EMG, EOG, ENG, blood pressure, pulse wave velocity, SpO2, pH, glucose, ions
- Environmental sensors
• Gas and particle sensors for air and breath monitoring
• Temperature sensors: body core and skin temperature
- Implantable micro/nanosensors and challenges for in-body sensing, communication and energy harvesting
- Wireless autonomous sensors for multiparameter sensing as components of a the healthcare cycle
• Standards for Body Area Networks (BAN) wireless communications with their merits and demerits as well as future standardization according tIEEE (Medradio, ISM, UWB, etc.)
• Ultra-low power radio front-ends and antennas for wearables
- Context driven wearable systems and the new industry ecosystem: wrist-based devices, smart glasses, smart patches
- Big and deep data analytics for healthcare: requirements for privacy and security
- Interoperability challenges for wearables and internet-of-things nodes

Part II (14 hours): Medical applications with focus on cardiovascular, metabolic and life style engineering: from prevention to intervention
• Cardiovascular System
- Anatomy, Physiology, Metabolism: from a cell to a pump
• Cadiovascular diseases :
- Epidemiology, economical burden
- Prevention and lifestyle monitoring: from 7 to 77 y.o: the Tintin rules.
- Treatment: overview of past, current and future interventions in cardiovascular medicine:
1. part I: Open heart surgery: from vessel to heart transplant (recorded intervention/live cases)
2. part II: Endovascular heart and vessels intervention: from stent to the cell (recorded intervention/live cases)

3. part III: Peri- and post-procedural monitoring, Cardiovascular reabilitation
• Unmet needs in Cardiovascular Medicine
- Integration of new technologies in the management of Cardiovascular patients
- Patients acceptance, Ethical and regulatory aspects

Keywords

wearable and implantable devices, internet-of-things, biosensors, health, personalized medecine, prevention, translational medicine, cardiovascular system, metabolic diseases.

Learning Prerequisites

Required courses

None.

Assessment methods

Written examination.

Resources

Websites

- http://nanolab.epfl.ch