MICRO-617

Energy Autonomous Wireless Smart Systems

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Cursus	Sem.	Type
Electrical Engineering		Obl.
Microsystems and Microelectronics		Obl.

Language of teaching	English
Credits	3
Session	
Exam	Multiple
Workload	90h
Hours	**42**
Lecture	42
Number of positions	**16**

Frequency

Every 2 years

Remark

Next time: 5-9 February 2018

Summary

The course provides in depth knowledge on how to design an energy autonomous microsystem embedding sensors with wireless transmission of information. It covers the energy generation, power management, and data processing and transmission with an emphasis on low-power and energy efficient operation.

Content

Monday 5.2.18: Neuchâtel
Tuesday 6.2.18: Lausanne
Wednesday 7.2.18: Lausanne
Thursday 8.2.18: Neuchâtel
Friday 9.2.18: Lausanne

Time: 9h to 18h (all days)
Location Lausanne: Room CO122
Location Neuchâtel: Room MC B1 283
Evaluation: Thursday, March 22nd - 9h to 17h: Salle CO121, EPFL Lausanne
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Introduction to Energy Autonomous Wireless Systems (D. Briand / 2h)
- Description of course organization and content
- Introduction to EAWS, building blocks, state of the art, applications, case studies

Energy sources and storage (D. Briand / 6h)
Working principles, technologies and comparison (efficiency, power density, potential applications) of energy sources and storage:
- Batteries, supercapacitors, micro-fuel cells
- Energy harvesters: solar, radiation, mechanical, thermal, chemical

RF, inductive and acoustic powering and backscattering wireless communication (C. Dehollain / 6h)
- Near field, far field and ultrasonic remote powering
- AC to DC converter (rectifier) and voltage regulator dedicated to magnetic, electro-magnetic and electro-acoustic coupling
- Charge storage on a large load capacitor, on a super-capacitor and on a rechargeable battery
- Remote powering RFID smart systems and sensor nodes
- Backscattering data communication for telecoms and biomedical application
- Load modulation for telecoms and biomedical applications

Ultra-low power and efficient electronics (K. Salimi / 6h)
- Converters for power sources and energy storage
- Electronics strategies for energy harvesters
- Electronics for sensors and low-power sensor usages
- Sensor selection criteria for low-power consumption
- Low-energy sensor data processing, storage and transmission strategies

Wireless communications (C. Botteron / 8h)
- Introduction: applications, characteristics, protocols and models;
- The wireless channel: propagation principles, link budget;
- Access and controls: coding, modulations, medium access controls, performance metrics;
- Existing wireless solutions: proprietary, standardized;
- Practical constraints with energy harvesting

Digital low power VLSI design (A. Burg / 3h)
- Power consumption in VLSI systems
- Low-power IC design techniques and physical limitations (reliability)
- Technology selection

System level design: Case studies (A. Burg / 3h)
- System-level design tradeoffs for low power: processing/storage/communications
- Component selection and integration
- Power management
- Case studies

Note

We will also propose this course to the EDEE program

Keywords

Autonomous, Electronics, Energy, Harvesting, Ultra Low-Power, Sensors, Communication

Learning Prerequisites

Recommended courses

Basics in electronics and in microelectronics

Assessment methods

Report and oral presentation