EE-518

Analog circuits for biochip

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Cursus	Sem.	Type
Bioengineering	MA2, MA4	Opt.
Data and Internet of Things minor	E	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Life Sciences Engineering	MA2	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

Introduction to analog CMOS design for Remote Biosensors on Chip. Understanding and designing of active and remotely powered biosensing systems. Basic understanding of eh wireless transmission of teh obtained signals

Content

Principles of biosensing: Target/Probe Interactions
Electrochemical biosensing: three-electrode electrochemical cell and its equivalent circuits
Basic CMOS configurations for electrochemical biosensing
Voltage-ramp generators on chip
Current readers: current-to-voltage and current-to-frequency conversion
Wireless transmission in lossy media: issues on temperature, specific absorption rate (SAR) and efficiency. Antennas for such devices
Regulation aspects of wireless transmission close or in living matter: maximum value of the SAR and the temperature with respect to the frequency of operation and the body tissue.
Power suppliers: non-rechargeable battery, rechargeable battery, super-capacitor, and storing capacitor
Different types of remote powering coupling between control units and remote biosensors
Passive (load modulation and backscattering) and active transmitters for RF communication
System Configuration for remote powering operation and data communication.

Keywords

OpAmp, CMOS, biosensors, RF communication, Remote Powering, wireless transmission

Learning Prerequisites

Required courses

Electronics I and II

Learning Outcomes

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

- Design complete devices for remote biosensing ata system level
- Design simple analog circuits for the biosensor frontend
- Design simple analog circuits for the RF data communication
- Design simple analog circuits for the remote powering operation
- Assess / Evaluate appropriate sources of information

Teaching methods

ex cathedra with supevised exercises

Assessment methods

exam

Resources

Bibliography

- Bio/CMOS interfaces and co-design / Carrara
- Design and optimization of passive UHF RFID systems / Curty