**Summary**

Introduction to analog CMOS design for Remote Biosensors on Chip. Understanding and designing of active and remotely powered biosensing systems. Basic understanding of the wireless transmission of the 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 at a 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 supervised exercises

Assessment methods
exam

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