Chemical Sensor Systems, 6.0 credits

Kemiska sensorsystem, 6.0 hp

Third-cycle education course

6FIFM51

Department of Physics, Chemistry and Biology

Valid from: First half-year 2025

Approved by **Approved**

Registration number

Entry requirements

Entry requirement for studies on third-cycle education courses

- Second-cycle degree,
- 240 credits in required courses, including at least 60 second-cycle credits, or
- Basic courses in physics, chemistry, electronics, biomedical engineering, biology, or environmental sciences

Learning outcomes

The purpose of the course is to provide in-depth understanding of chemical gas sensors (including all aspects ranging from the sensor principle to the application) and perform practical design and evaluation of gas monitoring systems based on chemical sensors.
After completing the course, the students are expected to be able to:

- Demonstrate a good overview of chemical sensor systems and their application areas
- Account for different sensor principles and detection mechanisms involved in chemical sensor systems
- Understand and account for the different parts of a sensor system, their importance, and the importance of sample handling, signal processing, and data analysis for a well-functioning sensor system
- Implement evaluation strategies and data processing in chemical sensor systems
- Analyse problems in measurement technology and identify and suggest different suitable sensor solutions
- Critically review literature in the field of chemical sensors and reflect upon shortcomings in contemporary sensor technologies and their applications
- Elaborate its own sensor or sensor system or sensor data analysis via practical exercises

Contents

The course starts with an overview and basic definitions in the scientific area of chemical sensors, including the operating principle of several commonly used chemical sensors. Measurement systems are studied in detail from sensor principle to application. The systems are chosen from the current research at the department and from industry and may e.g., be the "electronic nose" and the "electronic tongue" or biosensor systems based on surface plasmon resonance, QCM devices, blood monitoring devices for diabetes, sensors for environmental monitoring of GHG, air quality control for volatile organic compounds, or sensors based on ubiquitous devices like computer/mobile phone screens. As an introduction a short and brief overview of measurement technology, with emphasis on sensors for air quality monitoring and process control, is given. The measurement systems are then studied with respect to:

- Smart sensor operation and multivariate analysis of sensor data
- Smell and taste as scientific areas
- Data acquisition and data presentation
- Design of measurement systems, read-out electronics, amplifiers
- Sample handling
- Applications

The course contains hands-on and practical experiences by performing implementation of sensor systems, gas measurements, and data evaluation with the machine learning techniques that will be explained during the course.

Educational methods

Lectures and laboratory work on chemical sensor principles and applications.
A number of guest lecturers are invited to present special topics.
Visits to a research laboratory or to companies, which develops sensor systems, may be included.

Examination

Quizzes (1 hp)
Practical exercises (3 hp)
Laboratory work (2 hp)
Quizzes will show that the students have understood the important parts of the course and that they are able to use the acquired knowledge through the practical and laboratory work. Practical exercises and quizzes give grade U, G. Students' presence is required for a passing grade. Quizzes are in written form, and two reports (one for the practical exercises, one for the laboratory work) in written form are to be delivered before the end of the course.

Grading

Two grade scale, older version