UNIVERSITY of MISKOLC
Faculty of Materials and Chemical Engineering

Antal Kerpely Doctoral School of Materials Science & Technology

Modern Bioanalytical Technologies and Automation

Dr. Csaba Váradi

COURSE DESCRIPTION

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Author: Dr. Csaba Váradi

Modern Bioanalytical Technologies and Automation

Dr. Csaba Váradi

Lecturer

Dr. Csaba Váradi, Associate Professor,University of Miskolc, Faculty of Materials and Chemical Engineering, Department of Chemistry, H-3515 Miskolc-Egyetemváros, C/2. building, 2. Hajó, D-221

Recommendation

The couse is proposed for all students of the Antal Kerpely Doctoral School, with a special focus on students interested in bioanalytical chemistry.

Language

English.

Scope

This research area focuses on the technological development and automation of modern bioanalytical systems (e.g., high-resolution LC-MS, capillary electrophoresis), as well as novel sample preparation procedures (e.g., functional nanomaterials, chelating agents) for complex biomedical samples. A defining part of the research program is the processing of biological and chemical Big Data generated during high-throughput instrumental analyses. By applying chemometric methods, data mining, and transparent machine learning (AI) algorithms, the research aims at the predictive diagnostics of complex diseases and the identification of their molecular-level fingerprints (e.g., glycomic patterns). The subprogram organically integrates chemical technologies, interfacial phenomena, and modern data science.

Methodology

The course is delivered through face-to-face lectures and practical sessions. The lectures and exercises are structured to provide a comprehensive understanding of the approaches involved in various instrumental bioanalytical methods.

Topics

1. Design of instrumental analytical systems (mass spectrometry, chromatography).
2. High-throughput measurement setups.
3. Automated sample preparation (robotics).
4. Materials science aspects of separation technology (sensors, nanoparticles).

References

Chemometrics in Bioanalytical Chemistry

https://link.springer.com/chapter/10.1007/978-3-030-82381-8_26

Book in the topic:

Modern Bioanalytical Techniques ISBN 978-93-5834-569-8, Bioanalytical Chemistry Book, Analytical Techniques Book, Modern Laboratories Book, Biotechnology Book, Chemical Analysis Book

Exam

Project work.

Complex exam questions

1. Design and automation of modern bioanalytical systems: Describe the operating principles of high-throughput measurement setups, especially chromatography and mass spectrometry (e.g. high-resolution LC-MS) systems. Demonstrate the importance of automated sample preparation (robotics) in the analysis of complex biomedical samples.

2. Materials science and separation technology: Explain the materials science aspects of separation technology. Discuss the role of functional nanomaterials, sensors and chelators in new sample preparation procedures.

3. Computer processing of instrumental signals: Describe the steps of processing instrumental analytical signals (e.g. chromatograms and mass spectra), with special attention to noise filtering and mathematical-statistical evaluation of data.