Description of the Subject Taught at the IPC PAS Doctoral Warsaw School, 2024-2025

Teaching subject code	
Erasmus code	
Title of the teaching subject	Biosensing
Lecturer	Prof. Włodzimierz Kutner
Dates and location of classes	Winter semester 2024-2025, the Institute of Physical Chemistry, Polish Academy of Sciences, Warsaw
ECTS points	3
Assignment to a group of teaching subjects	Elective teaching subject
Language of lectures	English or Polish, depending on the attendees' preference
Brief description of the subject of teaching	Biosensing is a part of analytical chemistry covering methods for detecting and determining chemical compounds using biochemical sensors (biosensors), as well as designing, manufacturing, and testing those sensors. These methods will be discussed and illustrated with various examples, along with biosensors' devising, fabricating, testing, and applying. The lecture course's ultimate goal is to present the recent possibilities of biosensing to the extent that it enables independent deepening of knowledge within topics the student selects.
Form/type of teaching activity	One-semester 15-hour interactive lecture course ending with a written exam
Scope of lecture topics	1. Scope of the subject taught, basic concepts, and definitions. 2. Biochemical recognition (nucleic acids, proteins, etc.). 3. Electrochemical transduction. 4. Optical transduction. 5. Acoustic (piezomicrogravimetric) transduction. 6. Thermochemical transduction. 7. Semiconductive transduction. 8. Microcantilever transduction. 9. Multisensor arrays – electronic tongue. 10. Biosensors as detectors in flow bioanalytical systems (FIA, HPLC), including microfluidic systems. 11. Nanomaterials in biosensing. 12. Microorganisms, living cells, and tissues application in biosensing. 13. Wearable biosensors. 14. Statistical analysis of biochemical sensor data. 15. Trends in the future development of biosensing.
Entrance requirements	Basic B.Sc. and M.Sc. knowledge of physical chemistry (especially spectroscopy and electrochemistry), organic chemistry, and analytical chemistry
Learning outcomes	The lecture course will enable the student to learn the basic methods of detecting and determining chemical compounds, especially those of biological importance, using biochemical sensors.
Methods and criteria of student assessment	The written exam covering topics taught will be rated at a maximum of 100 points; the student must score at least 60 points to pass the exam.
Literature	- F.-G. Banica, *Chemical Sensors and Biosensors: Fundamentals and Applications*, Wiley, 2012 - B. R. Eggins, *Chemical Sensors and Biosensors: 2 (Analytical Techniques in the Science (AnTs))*, Wiley, 2002 - G. Orellana, Moreno-Bondi, *Frontiers in Chemical Sensors: Novel Principles and Techniques (Springer Series on Chemical Sensors and Biosensors)*, Springer, 2005 - Santos, J. L., Farahi, F., *Handbook of optical sensors*, CRC Press, Taylor & Francis Group, 2017 - S. Cosnier (Ed.), *Electrochemical Biosensors*, Pan Stanford Publishing Pte. Ltd., 2015 - R. Lalauze (Ed.), *Chemical Sensors and Biosensors*, (Wiley-ISTE, 2012) - Kutner, W., Sharma, P. S., (Eds.), *Molecularly Imprinted Polymers for Analytical Chemistry Applications,* in *Polymer Chemistry Series* No. 28, The Royal Society of Chemistry, 2018 - Sazonov, E. (Ed.), *Wearable sensors: fundamentals, implementation, and applications*, Academic Press, 2020 - Z. Brzózka, E. Malinowska, W. Wróblewski, *Sensory chemiczne i biosensory*, PWN, 2022.