## "ZATWIERDZAM"

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**KARTA INFORMACYJNA PRZEDMIOTU/ZAJĘĆ** (wersja anglojęzyczna w przypadku przedmiotu/zajęć w j. angielskim)

Name of subject	-	Measurements in chemistry
Code:	и 	
Language:	english	
Profile:	practical	
Mode of study:	full-time studies	
Form of study:	second-cycle studies	
Type of subject:	optional	
Valid from:	2022/2023	
Form of course / number of hours / final requirement:	lecture: 14 hours – pass with grade exercises: 8 hours - pass without grade laboratories: 8 hours - pass without grade ECTS: 2	
Introductory subjects:	Mathematics (basics of mathematical analysis and differential calcu- lus, elements of probability theory). Physics (basic theory of electricity and magnetism, phenomena of transport of liquids and gases).	
Term / field of study:	III / chemistry	
Author:	Michał Grabka, PhD	
Faculty:	Faculty of Advanced Technologies and Chemistry	
Short description:	The main goal of the lectures is to teach the basics of the theory of experiments and theoretical models of measurement instruments as well as to transfer knowledge about modern methods of experimental methods specific to Chemistry.	
Description:	LECTURES 1. Elements of measurement theory 1.1. Measurement and metrology – basic concepts/2 hours 1.2. Static and dynamic properties of measuring transducers/2 hours 2. Methods of measuring electrical quantities 2.1. Electrical quantities/2 hours 2.2. DC and AC circuits, semiconductor elements /2 hours 2.3. Methods of measuring electrical quantities/2 hours 3. Methods of measuring non-electrical quantities used in chemical laboratories 3.1. Phenomena and effects used in sensors to measure non-electric quantities. Pressure measurement, flow measurement, temperature measurement/2 hours 3.2. Chemical sensors: electrochemical, thermochemical (catalytic), electrical, ionization, gravimetric/2 hours EXERCISES	

	As part of the accounting exercises, tasks related to the following problems are solved: - calculation of measurement uncertainty and error propagation/2 hours - static and dynamic characteristics of measuring transducers/2 hours - elements of the theory of linear circuits/2 hours - processing signals from measurement sensors/2 hours LABORATORIES Students perform laboratory exercises devoted to: - methods of measuring electrical quantities/4 hours - testing the characteristics of measurement sensors/4 hours
Bilbiography:	<ol> <li>J. R. Taylor, An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements-2nd ed., University Science Books,</li> <li>Warszawa 1996.</li> <li>C. Alexander. Fundamentals of electronic circuits – 4th ed., The McGraw-Hill Companies, 2009.</li> <li>P. Horowitz, W. Hill, The Art of Electronics 3rd ed., Cambridge University Press, 2015.</li> <li>J. Fraden, Handbook of modern sensors: Physics, Designs, and Applications, Springer 2015</li> </ol>
Learning outcomes:	W1. The student has well-established and extended knowledge in the selected specialty / K_W02 W2. The student knows classical and instrumental analytical meth- ods, their analytical possibilities, and theoretical foundations. Knowledge of methods for checking the reliability of quantitative chemical analy- sis results and statistical methods for assessing analysis results. Knows the development trends of analytical equipment / K_W12 U1. The student is able to determine the structure of materials and their physicochemical properties based on X-ray, adsorption, thermophysical, optical, and other tests / K_U07 U2. The student is able to critically evaluate the results of experi- ments, observations, and theoretical calculations, as well as discuss measurement errors / K_U08 K1. The student is ready to perform professional roles responsibly, taking into account changing social needs, including developing the achievements of the profession, maintaining the ethos of the profes- sion, observing and developing the principles of professional ethics, and working to comply with these principles / K_K03
Assessment methods and assessment criteria:	Lectures on the subject are passed on the basis of a written examina- tion. The questions asked during the exam concern the knowledge provided during lectures and acquired independently by the student while studying the topics of the lectures. The condition for obtaining a positive grade is to demonstrate the knowledge specified in the learn- ing outcomes at an at least sufficient level. The condition for passing the course is passing the exercises and laboratories. The classes are assessed on the basis of a final test. The final test in- cludes accounting tasks related to the subject of the exercises. The laboratory is assessed on the basis of grades from colloquiums, allowing the completion of individual laboratory exercises and grades from reports. The topics of the colloquiums allowing for the implemen- tation of individual laboratory exercises include the content in the laboratory instructions and the knowledge acquired by students dur- ing their preparation for the laboratories. The achievement of W1 and W2 outcomes is checked when passing lectures and when answering questions during exercises and laboratories. Achieving the U1, U2, and K1 effects are checked during exercises and laboratories.
ECTS balance	Activity/Load per hour 1. Participation in lectures/14 2. Independent study of lecture topics/10

<ol> <li>Participation in exercises/8</li> <li>Independent preparation for exercises/6</li> <li>Participation in laboratories/8</li> <li>Independent preparation for laboratories/6</li> <li>Participation in consultations/2</li> <li>Preparation for the exam/6</li> </ol>
Hours/ECTS Total student workload: 60/2 Classes with teachers: 32/2 Activities related to scientific activity: 60/2

autor

kierownik jednostki organizacyjnej odpowiedzialnej za przedmiot

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