



## Subject card

Subject name and code	Experiment design and analysis, PG_00061894						
Field of study	Materials Engineering						
Date of commencement of studies	October 2024	Academic year of realisation of subject			2024/2025		
Education level	first-cycle studies	Subject group			Obligatory subject group in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	1	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Instytut Nanotechnologii i Inżynierii Materiałowej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Barbara Kościelka					
	Teachers	prof. dr hab. inż. Barbara Kościelka dr inż. Marta Prześniak-Welenc dr inż. Marcin Łapiński dr inż. Ewa Głowińska					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	30.0	0.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours		Self-study		SUM
	Number of study hours	60	5.0		60.0		125
Subject objectives	The aim of the course is to familiarize the student with basic information regarding the process of planning, performing and publishing experimental data.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W06] Knows selected methods, techniques, tools and materials used in solving simple engineering problems within the scope of materials engineering.	The student is able to analyze a series of measurement data, present the results in the form of clear graphs, and analyze measurement uncertainties			[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects		
	[K6_U01] Can properly use selected analytical, simulation and experimental methods, as well as devices for measuring the fundamental properties of materials and technological processes.	The student is able to plan an experiment and conduct simple measurement experiments. Is able to correctly analyze the received measurement data			[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools		
	[K6_U02] Can operate typical laboratory equipment and analyze material tests	The student is able to plan an experiment and conduct simple measurement experiments. Is able to correctly analyze the received measurement data			[SU5] Assessment of ability to present the results of task [SU1] Assessment of task fulfilment		
	[K6_U11] Is able to notice non-technical aspects when forming and solving project tasks, including environmental, economic and legal aspects. Applies the rules of occupational health and safety.	The student knows and understands the hazards in laboratory work. Student basic principles of research ethics.			[SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	<p><b>Lectures/exercises</b></p> <ol style="list-style-type: none"> <li>1. Sources of scientific and non-scientific knowledge.</li> <li>2. Measurement errors and uncertainties.</li> <li>3. Statistical distribution of measurements.</li> <li>4. Measurements and measurement uncertainties of complex quantities.</li> <li>5. Graphical and tabular presentation of measurement results.</li> <li>6. Determination of physical parameters from graphs.</li> <li>7. Linear regression method. Planning simple physical experiments.</li> <li>8. Principles of presenting measurement results. Creating a report.</li> <li>9. Principles of preparing scientific publications.</li> </ol> <p><b>Laboratory</b></p> <ol style="list-style-type: none"> <li>1. Planning of experiments in the field of chemistry in accordance with the principles of green chemistry and BAT (best available technologies).</li> <li>2. The Reach system as a determinant in planning chemical experiments and selecting raw materials for syntheses.</li> <li>3. Methods of planning experiments and measurements of engineering materials, including methods of detecting errors in measurement techniques.</li> <li>4. Quantitative analysis using spectrophotometry based on calibration curve, dependence of absorbance on concentration of standard substance, Lambert-Beer law.</li> <li>5. Procedure for preparation of standard solutions, analysis of changes in conditions (e.g. temperature, batches of reagents), preparation of the work curve for each day of measurement.</li> <li>6. Calculation of expected value based on arithmetic mean of results, standard deviation, and elimination of gross errors.</li> </ol>														
Prerequisites and co-requisites	Knowledge of mathematics at secondary school level														
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="456 1895 794 1921">Subject passing criteria</th> <th data-bbox="799 1895 1137 1921">Passing threshold</th> <th data-bbox="1142 1895 1481 1921">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="456 1928 794 1977">Laboratory - passing all laboratory exercises</td> <td data-bbox="799 1928 1137 1977">50.0%</td> <td data-bbox="1142 1928 1481 1977">50.0%</td> </tr> <tr> <td data-bbox="456 1984 794 2011">Lecture - written test</td> <td data-bbox="799 1984 1137 2011">50.0%</td> <td data-bbox="1142 1984 1481 2011">25.0%</td> </tr> <tr> <td data-bbox="456 2018 794 2045">Exercises - written test</td> <td data-bbox="799 2018 1137 2045">50.0%</td> <td data-bbox="1142 2018 1481 2045">25.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Laboratory - passing all laboratory exercises	50.0%	50.0%	Lecture - written test	50.0%	25.0%	Exercises - written test	50.0%	25.0%
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Recommended reading	Basic literature	<p><b>Lecture/exercises</b></p> <ol style="list-style-type: none"> <li>1. B. Kusz, Metody wykonywania pomiarów oraz szacowanie niepewności pomiaru (<a href="https://pg.edu.pl/files/ftims/2021-03/wstep.pdf">https://pg.edu.pl/files/ftims/2021-03/wstep.pdf</a> )</li> <li>2. K. Kozłowski, R. Zieliński I Laboratorium z Fizyki część I Wydawnictwo PG.</li> <li>3. Dudkiewicz J, Kusz B, Laboratorium z Fizyki, część 2, Wydawnictwo PG.</li> <li>4. Wstęp do analizy błędu pomiarowego, Wydawnictwo PWN</li> </ol> <p><b>Laboratory</b></p> <ol style="list-style-type: none"> <li>1. B. Burczyk, Zielona chemia. Zarys, Oficyna Wydawnicza Politechniki Wrocławskiej, 2014</li> <li>2. Najlepsze Dostępne Techniki (BAT) Wytyczne dla Branży Chemicznej w Polsce (<a href="https://www.ekoportal.gov.pl/fileadmin/Ekoportal/Pozwolenia_zintegrowane/poradniki_branzowe/11.5_Systemy_Obrobki_Zarządzania_Wodami_i_Gazami_Odpadowy">https://www.ekoportal.gov.pl/fileadmin/Ekoportal/Pozwolenia_zintegrowane/poradniki_branzowe/11.5_Systemy_Obrobki_Zarządzania_Wodami_i_Gazami_Odpadowy</a>)</li> <li>3. <a href="https://www.gov.pl/web/rozwoj-technologie/system-reach">https://www.gov.pl/web/rozwoj-technologie/system-reach</a></li> <li>4. Analiza statystyczna w laboratorium badawczym, PWN, Wojciech Hyk, Zbigniew Stojek</li> </ol>
	Supplementary literature	-
	eResources addresses	Adresy na platformie eNauczanie: Metody planowania i analizy eksperymentu - Moodle ID: 39676 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=39676">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=39676</a>

<p>Example issues/ example questions/ tasks being completed</p>	<p><b>Lecture/exercises</b></p> <ol style="list-style-type: none"> <li>1. Calculate the standard deviation for the given series of experimental data.</li> <li>2. Provide the sources of measurement uncertainties.</li> <li>3. Draw a line graph from the given data, calculate the slope of the line and the fit coefficient.</li> </ol> <p><b>Laboratory</b></p> <ol style="list-style-type: none"> <li>1. Determination of a calibration curve taking into account all points for individual concentrations, with rejection of gross errors for various measuring devices: glass pipettes and measuring cylinders.</li> <li>2. Preparation of detailed tables of results for individual students and the mean and standard deviation.</li> <li>3. Calculation of SSE for parameters a and b, along with a description of the uncertainty for the result of a sample with an unknown concentration.</li> <li>4. Application of the dilution method in the preparation of the standard curve, as well as the tested sample.</li> <li>5. Determination of LOD and LOQ for the obtained curve.</li> <li>6. Designing and making a simple research device and conducting an experiment. For example, measuring air temperature.</li> <li>7. Taking a series of measurements and correlating the number of cars in a parking lot with the air temperature.</li> </ol>
<p>Work placement</p>	<p>Not applicable</p>

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