GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Planning of experiments and error analysis, PG_00057365		
Field of study	Mechanical Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2022/2023
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research 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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Paweł Dąbrowski	
	Teachers	dr inż. Paweł Dąbrowski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	15.0	0.0	0.0	0.0	30

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	30	6.0	14.0	50

Subject objectives

The subject aims to familiarize students with the idea of experimental work, from planning the experiment, through the acquisition and interpretation of measurement data, to drawing conclusions based on them. In addition, the subject aims to familiarize students with the importance of measurement uncertainty in experimental research as well as to show good practices in conducting experimental work. This subject will teach the student how to plan and run an experiment, and how to interpret the data and compare it with scientific theories, taking into account measurement uncertainty.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W01] possesses a profound mathematical knowledge useful in the analysis and description of the operation of complex mechanical systems, technological processes and operating properties of machines and devices; is familiar with the main development trends	The ability to experimental data curation using mathematical and statistical analysis	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge
[K7_U05] is able to plan and conduct the experimental research determining the parameters of a device or system, assesses the usability and correctly selects methods and tools, is able to interpret the results and estimate the measurement errors and is able to apply computer systems to simulate the operation of a machine or technology	The ability to design an experiment in the field of machinery and equipment or technology and theoretical results elaboration, using a variety of techniques and tools, including the calculation of measurement uncertainty	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
[K7_W07] possesses profound knowledge on the diagnostics and monitoring of the condition of devices, assemblies and technical systems, as well as measurement methods of process and operation control	The ability to design and carry out experimental work based on measurements of physical quantities and their curation, enabling diagnostics and monitoring of the machines and devices operation	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>1. Basic concepts
2. Experiment in historical and philosophical perspective
3. Examples of simple experiments
4. Basics of experiment design
5. Input, output, control, dependent, and independent variables
6. Qualitative and quantitative measurements
7. Uncertainties and measurement errors
8. Acquisition of measurement data
9. Statistical analysis of measurement data
10. Utilization of measurement data for calculations
11. Numerical methods as an experiment aiding tools
12. Good practices in designing and conducting experimental research
13. Designing and conducting an experiment - a case study</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge of basic mathematical concepts with particular emphasis on the concepts of mathematical statistics. Basic knowledge of machine construction, thermal-flow and material strength measurements.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Tutorial - writing assessment</td><td>60.0%</td><td>40.0%</td></tr>
<tr><td>Lecture - writing assessment</td><td>60.0%</td><td>60.0%</td></tr>
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<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>1. Montgomery D.C. Design and analysis of experiments. Eighth Edition. Wiley & Sons, 2013, ISBN: 978-1-118-14692-7</td></tr>
<tr><td>Supplementary literature</td><td>1. Abu-Mulaweh H. Integration a ddesign of experiment in the heat transfer laboratory. Annual Conference Proceedings, 2003, DOI: 10.18260/1-2--11948
2. Luiten W. Design of experiments in thermal architecture. 23rd International Workshop on Thermal Investigations of ICs and Systems (THERMINIC), 2017, DOI: 10.1109/THERMINIC.2017.8233785
3. Prima EC, Utari S, Chandra DT, Hasanah L, Rusdiana D. Heat and temperature experiment designs to support students conception on nature of science. Journal of Technology and Science Education, 2018, DOI: 10.3926/jotse.419</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Planowanie Eksperymentu i Analiza Błędów, W, MiBM, sem.01, letni 22/23 (PG_00057365) - Moodle ID: 29155
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29155
Planowanie Eksperymentu i Analiza Błędów, W, MiBM, sem.01, letni 22/23 (PG_00057365) - Moodle ID: 29155
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29155</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Definitions: experiment, input variable, output variable, control variable, dependent variable, independent variable, repeatability, sensitivity
2. Measurement uncertainty
3. Statistical analysis of measurement data
4. Differences between experimental and non-experimental research
5. False positive results
6. Double-blind design
7. Design an experiment to measure the emissivity of the body
8. Design an experiment to measure the Young's modulus of the material
9. Design an experiment to measure the hardness of the material
10. Influence of various factors on the results of the experiment</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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