



## Subject card

Subject name and code	Measurements and Measurement Systems, PG_00042054						
Field of study	Power Engineering, Power Engineering						
Date of commencement of studies	October 2022		Academic year of realisation of subject		2023/2024		
Education level	first-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	2		Language of instruction		English		
Semester of study	4		ECTS credits		5.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Metrology and Information Systems -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Ariel Dzwonkowski				
	Teachers		dr inż. Ariel Dzwonkowski				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	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		10.0		55.0	125
Subject objectives	Familiarize students with issues related to metrology and measurement systems.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K6_U02] is able to apply the learned mathematical methods to the analysis and design of elements, systems and energy systems						
	[K6_W05] has structured knowledge in the field of electrical engineering and electronics, necessary to understand the basics of operation and selection of electrical machines, electricity transmission systems and power electronic devices						
Subject contents	<p>LECTURE: Basic concepts of measurement. Measurement methods. The theory of measurement errors and uncertainty. Converters. The structure of measuring instruments. Analog and digital measuring instruments. Ways of extending the measuring ranges. Measurement bridges. Measurements of basic electrical quantities (voltage and current, resistance, inductance, capacity, frequency, phase shift, power and energy in single and three-phase circuits). Measurements of non-electrical quantities by electrical methods. Analog-to-digital converters of mechanical quantities. Electrical temperature measurements. Stress measurement. Measurement and diagnostic systems. Measurement software. Interfaces in measurement systems. Measurement data transmission methods: wired and wireless. Vision and infrared measurement systems. Virtual measuring instruments. The use of virtual instruments in the measurement and design of basic measurement systems.</p> <p>LABORATORY: Calibration of measuring devices. Measurements using an oscilloscope. Measurements of RLC elements parameters. Measurements of frequency and rotational speed. Measurement of earth resistance and short circuit loop impedance. Power measurement in three-phase circuits. Temperature measurement. Computer measuring systems.</p>						
Prerequisites and co-requisites							

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Entry tests nad reports- lab.	60.0%	50.0%
	28 / 5000 Wyniki tłumaczenia Written test - lecture.	60.0%	20.0%
	Homework and presentations - lecture.	60.0%	30.0%
Recommended reading	Basic literature	1. Alan S Morris Reza Langari: Measurement and Instrumentation. Theory and Application. Elsevier, 2012. ISBN: 978-0-12-381960-4.  2. Handbook of Measurements: Benchmarks for Systems Accuracy and Precision. CRC Press, 2015. PrintISBN: 978-1-4822-2522-8.  3.Raghavendra, N.V.; Krishnamurthy, L.: Engineering Metrology and Measurements. Published by OxfordUniversity Press, 2013. ISBN 9780198085492.	
	Supplementary literature	1. Parchański J.: Miernictwo elektryczne i elektroniczne, WSiP, Warszawa, Wydanie ósme 2006.  2. Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna, WNT, Warszawa 1979, 2003.  3. Gawędzki W.: Pomiary elektryczne wielkości nieelektrycznych, Wydawnictwo AGH, Kraków, 2010.  4. Czabanowski R.: Sensory i systemy pomiarowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2010	
	eResources addresses	Adresy na platformie eNauczanie: Measurements and Measurements Systems [2023/24] - Moodle ID: 34165 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34165">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34165</a>	
Example issues/ example questions/ tasks being completed	1. Causes of errors: systematic, random and coarse. Ways to reduce these errors.  2 How to estimate the measurement uncertainty as type A and type B?  3. Derive the diagram and the method of balancing the Wheatstone bridge.  4. Active and reactive power measurement systems in a three-phase, four-wire system.  5. Systems for measuring active and reactive power in a three-phase three-wire system.		
Work placement	Not applicable		