



## Subject card

Subject name and code	Measurements and Measurement Systems, PG_00055884						
Field of study	Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	October 2021	Academic year of realisation of subject				2022/2023	
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				Polish	
Semester of study	3	ECTS credits				4.0	
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. Anna Golijanek-Jędrzejczyk					
	Teachers	dr inż. Beata Pałczyńska dr inż. Michał Ziółko dr inż. Anna Golijanek-Jędrzejczyk 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	15.0	0.0	0.0	45
	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	45	6.0		49.0		100
Subject objectives	Familiarizing 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	Student explains the structure and principle operation of measurement systems. The student explains the rules of selection tools and measurement methods relevant to the task measuring. Student discusses development of the results measurement, evaluates errors and measurement uncertainty.			[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment		
	[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	Student uses correctly with standard instruments analog and digital. The student carries out projects size measuring systems electric and non-electric. Student presents physical principles of operation and properties basic metrology transducers for measurements non-electrical quantities.			[SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
Subject contents	Basic metrological concepts. Measurement methods. Fundamentals of the calculus of errors i development of measurement results. Measuring converters for electrical quantities. Analog and digital meters. Ways of extending the measuring ranges. Measurements of basic electrical quantities (voltage and current, resistance, inductance, capacitance, frequency, phase shift, power and energy in single and three-phase circuits). Measurements of non-electrical quantities by electrical methods. Electrical temperature measurements. Resistance and thermoelectric thermometers, pyrometers. The use of thermovision in measurements. Tensometric measurements of mechanical quantities. Measurement systems - classification, structure and application.						

Prerequisites and co-requisites	Basic knowledge of electrical engineering and physics.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Laboratory.	60.0%	50.0%
	Written test - lecture.	60.0%	50.0%
Recommended reading	Basic literature	1. Parचाński J.: Miernictwo elektryczne i elektroniczne, WSiP, Warszawa, Wydanie ósme 2006. 2. Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna, WNT, Warszawa 2012. 3. Gawędzki W.: Pomiary elektryczne wielkości nieelektrycznych, Wydawnictwo AGH, Kraków, 2010. 4. Czabanowski R.: Sensory i systemy pomiarowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2010	
	Supplementary 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. Print ISBN: 978-1-4822-2522-8. 3. Raghavendra, N.V.; Krishnamurthy, L.: Engineering Metrology and Measurements. Published by Oxford University Press, 2013. ISBN 9780198085492.	
	eResources addresses		
Example issues/ example questions/ tasks being completed	1. Causes of errors: systematic, random and gross. Ways to reduce these mistakes.  2. How is the measurement uncertainty of type A and type B defined?  3. Give the diagram and the method of balancing the Wheatstone bridge.  4. What is phase measurement with a dual-channel oscilloscope by comparison method?  5. Present the systems for measuring active and reactive power in a three-phase, four-wire system unbalanced.  6. Present the systems for measuring active and reactive power in a three-phase, three-wire system symmetrical.		
Work placement	Not applicable		