



## Subject card

Subject name and code	Measurements and Measurement Systems, PG_00042054						
Field of study	Power Engineering, Power Engineering, Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2021/2022		
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. Anna Golijanek-Jędrzejczyk					
	Teachers	dr inż. Ariel Dzwonkowski dr inż. Anna Golijanek-Jędrzejczyk					
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 Adresy na platformie eNauczanie:						
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_W08	The student correctly uses analogue and digital measuring instruments.			[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge		
	K6_U03	Student configures measurement systems. The student designs measurement systems for measuring electrical and non-electrical quantities. Student presents the principle of operation of transducers.			[SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information		

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	<table border="1" data-bbox="448 584 1489 770"> <thead> <tr> <th data-bbox="448 584 794 618">Subject passing criteria</th> <th data-bbox="794 584 1141 618">Passing threshold</th> <th data-bbox="1141 584 1489 618">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 618 794 674">Homework and presentations - lecture.</td> <td data-bbox="794 618 1141 674">60.0%</td> <td data-bbox="1141 618 1489 674">30.0%</td> </tr> <tr> <td data-bbox="448 674 794 730">28 / 5000 Wyniki tłumaczenia Written test - lecture.</td> <td data-bbox="794 674 1141 730">60.0%</td> <td data-bbox="1141 674 1489 730">20.0%</td> </tr> <tr> <td data-bbox="448 730 794 770">Entry tests nad reports- lab.</td> <td data-bbox="794 730 1141 770">60.0%</td> <td data-bbox="1141 730 1489 770">50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Homework and presentations - lecture.	60.0%	30.0%	28 / 5000 Wyniki tłumaczenia Written test - lecture.	60.0%	20.0%	Entry tests nad reports- lab.	60.0%	50.0%
Subject passing criteria	Passing threshold	Percentage of the final grade													
Homework and presentations - lecture.	60.0%	30.0%													
28 / 5000 Wyniki tłumaczenia Written test - lecture.	60.0%	20.0%													
Entry tests nad reports- lab.	60.0%	50.0%													
Recommended reading	<table border="1" data-bbox="448 777 1489 1559"> <tbody> <tr> <td data-bbox="448 777 794 1111">Basic literature</td> <td colspan="2" data-bbox="794 777 1489 1111"> <p>1. Alan S Morris Reza Langari: Measurement and Instrumentation. Theory and Application. Elsevier, 2012. ISBN: 978-0-12-381960-4.</p> <p>2. Handbook of Measurements: Benchmarks for Systems Accuracy and Precision. CRC Press, 2015. Print ISBN: 978-1-4822-2522-8.</p> <p>3. Raghavendra, N.V.; Krishnamurthy, L.: Engineering Metrology and Measurements. Published by Oxford University Press, 2013. ISBN 9780198085492.</p> </td> </tr> <tr> <td data-bbox="448 1111 794 1529">Supplementary literature</td> <td colspan="2" data-bbox="794 1111 1489 1529"> <p>1. Parchański J.: Miernictwo elektryczne i elektroniczne, WSiP, Warszawa, Wydanie ósme 2006.</p> <p>2. Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna, WNT, Warszawa 1979, 2003.</p> <p>3. Gawędzki W.: Pomiary elektryczne wielkości nieelektrycznych, Wydawnictwo AGH, Kraków, 2010.</p> <p>4. Czabanowski R.: Sensory i systemy pomiarowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2010</p> </td> </tr> <tr> <td data-bbox="448 1529 794 1559">eResources addresses</td> <td colspan="2" data-bbox="794 1529 1489 1559"></td> </tr> </tbody> </table>			Basic literature	<p>1. Alan S Morris Reza Langari: Measurement and Instrumentation. Theory and Application. Elsevier, 2012. ISBN: 978-0-12-381960-4.</p> <p>2. Handbook of Measurements: Benchmarks for Systems Accuracy and Precision. CRC Press, 2015. Print ISBN: 978-1-4822-2522-8.</p> <p>3. Raghavendra, N.V.; Krishnamurthy, L.: Engineering Metrology and Measurements. Published by Oxford University Press, 2013. ISBN 9780198085492.</p>		Supplementary literature	<p>1. Parchański J.: Miernictwo elektryczne i elektroniczne, WSiP, Warszawa, Wydanie ósme 2006.</p> <p>2. Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna, WNT, Warszawa 1979, 2003.</p> <p>3. Gawędzki W.: Pomiary elektryczne wielkości nieelektrycznych, Wydawnictwo AGH, Kraków, 2010.</p> <p>4. Czabanowski R.: Sensory i systemy pomiarowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2010</p>		eResources addresses					
Basic literature	<p>1. Alan S Morris Reza Langari: Measurement and Instrumentation. Theory and Application. Elsevier, 2012. ISBN: 978-0-12-381960-4.</p> <p>2. Handbook of Measurements: Benchmarks for Systems Accuracy and Precision. CRC Press, 2015. Print ISBN: 978-1-4822-2522-8.</p> <p>3. Raghavendra, N.V.; Krishnamurthy, L.: Engineering Metrology and Measurements. Published by Oxford University Press, 2013. ISBN 9780198085492.</p>														
Supplementary literature	<p>1. Parchański J.: Miernictwo elektryczne i elektroniczne, WSiP, Warszawa, Wydanie ósme 2006.</p> <p>2. Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna, WNT, Warszawa 1979, 2003.</p> <p>3. Gawędzki W.: Pomiary elektryczne wielkości nieelektrycznych, Wydawnictwo AGH, Kraków, 2010.</p> <p>4. Czabanowski R.: Sensory i systemy pomiarowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2010</p>														
eResources addresses															
Example issues/ example questions/ tasks being completed	<ol data-bbox="448 1565 1489 1962" style="list-style-type: none"> <li>1. Causes of errors: systematic, random and coarse. Ways to reduce these errors.</li> <li>2. How to estimate the measurement uncertainty as type A and type B?</li> <li>3. Derive the diagram and the method of balancing the Wheatstone bridge.</li> <li>4. Active and reactive power measurement systems in a three-phase, four-wire system.</li> <li>5. Systems for measuring active and reactive power in a three-phase three-wire system.</li> </ol>														
Work placement	Not applicable														