



## Subject card

Subject name and code	Metrology, PG_00047552						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	October 2021		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	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		1.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Metrology and Optoelectronics -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Sylwia Babicz-Kiewlicz				
	Teachers		dr inż. Sylwia Babicz-Kiewlicz  dr inż. Stanisław Galla				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	E-learning hours included: 0.0						
	Address on the e-learning platform: <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=20086">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=20086</a> Adresy na platformie eNauczanie:						

Additional information:  
Presentations from the lectures are only auxiliary materials. Providing students with a presentation does not exempt them from the need to take their own lecture notes and does not replace the independent study of the applicable textbooks. The lecture is only a supplement to the student's independent work. The colloquium is valid for the scope of the material actually laid out during the lecture and contained in the corresponding fragments of the textbooks given in the list of literature for the lecture.

Completion of the lecture in the subject takes place in the multiple-choice test after a minimum of two weeks from the last lecture.

Place: rooms EA222 / EA442

Groups of 16 people will be admitted to the room and they will solve the test on the e-learning platform on laboratory computers.

Time to perform the test: 15 minutes

Number of questions: 20 (10 from S. Babicz, 10 from St. Gall)

After the time has elapsed, an open sample will be saved automatically.

Multiple answers will be possible and the questions are tested with zero-one. So if the answers A and C are correct, then in order to get one point for the question, you need to mark exactly the answers A and C. Any other combination will result in not assigning a point for this question.

Baseline results will be known as soon as the test is completed.

Grades must be issued by the end of the class. Therefore, the retake date will take place before the end of the class, but not sooner than 5 days after the basic test is written.

The maximum grade that can be obtained from the resit date is 3.

Percentage thresholds for individual ratings:

<0; 49>% 2

<50; 60>% 3

<60; 70>% 3.5

<70; 80>% 4

<80; 90>% 4.5

<90; 100>% 5

It is not possible to increase the grade / performance of an additional task for a higher grade etc.

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	15	1.0	9.0	25
Subject objectives		The aim is introduction to : the essence of measurement, units and standards, methods of measurement, analysis of measurement uncertainty, basic instruments for measurement of electrical quantities.			

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W03] Knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	Student knows the structure and metrological properties of instruments for measuring basic electrical quantities. He knows the principles of operation of analog / digital converters. Student knows the methods of constructing measurement systems.	[SW1] Assessment of factual knowledge
	[K6_W02] Knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study	He knows the basic metrological terms. He knows the measurement methods. It strictly defines the measurand (menzurand). It presents the results of measurements according to the recommendations of the International System of Units (SI), using the correct markings and prefixes to create multiple and submultiple units of measurement. Student analyzes systematic errors in direct and indirect measurements. Student knows the causes of measurement uncertainty and methods of its minimization during measurements. Assesses the measurement uncertainty with the A-method and B-methods.	[SW1] Assessment of factual knowledge
Subject contents	1. Introduction, basic metrological terms, classification of measurement methods 2. Measurement errors, types of errors: systematic, random, gross 3. Permanent-magnet moving-coil instrument and its application 4. Digital methods of low and high frequency measurements 5. Digital methods of time-interval and phase measurements 6. Dual-slope integration ADC 7. Immunity of integration ADCs from disturbances 8. Flash and subranging ADC 9. Digital multimeters: architecture, resistance to voltage converter, current to voltage converter, multiterminal inputs 10. AC voltage measurements, waveform parameters, average value, peak value and RMS measurements 11. Oscilloscope: architecture, principles of operation 12. Measurements of voltage, frequency, phase, parameters of pulse, display of device characteristics 13. Measurement uncertainty 14. Measurement methods of impedance parameters R, L, C,  Z  15. Measuring systems and virtual instruments.		

Prerequisites and co-requisites	<p>Presentations from the lectures are only auxiliary materials. Providing students with a presentation does not exempt them from the need to take their own lecture notes and does not replace the independent study of the applicable textbooks. The lecture is only a supplement to the student's independent work. The colloquium is valid for the scope of the material actually laid out during the lecture and contained in the corresponding fragments of the textbooks given in the list of literature for the lecture.</p>		
	<p>Completion of the lecture in the subject takes place in the multiple-choice test after a minimum of two weeks from the last lecture.</p>		
	<p>Place: rooms EA222 / EA442</p>		
	<p>Groups of 16 people will be admitted to the room and they will solve the test on the e-learning platform on laboratory computers.</p>		
	<p>Time to perform the test: 15 minutes</p>		
	<p>Number of questions: 20 (10 from S. Babicz, 10 from St. Gall)</p>		
	<p>After the time has elapsed, an open sample will be saved automatically.</p>		
	<p>Multiple answers will be possible and the questions are tested with zero-one. So if the answers A and C are correct, then in order to get one point for the question, you need to mark exactly the answers A and C. Any other combination will result in not assigning a point for this question.</p>		
	<p>Baseline results will be known as soon as the test is completed.</p>		
	<p>Grades must be issued by the end of the class. Therefore, the retake date will take place before the end of the class, but not sooner than 5 days after the basic test is written.</p>		
Assessment methods and criteria	<p>The maximum grade that can be obtained from the resit date is 3.</p>		
	<p>Percentage thresholds for individual ratings:</p>		
	<p>&lt;0; 49&gt;% 2</p>		
	<p>&lt;50; 60)% 3</p>		
	<p>&lt;60; 70)% 3.5</p>		
	<p>&lt;70; 80)% 4</p>		
	<p>&lt;80; 90)% 4.5</p>		
	<p>&lt;90; 100&gt;% 5</p>		
	<p>It is not possible to increase the grade / performance of an additional task for a higher grade etc.</p>		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Colloquium	50.0%	100.0%

Recommended reading	Basic literature	<ul style="list-style-type: none"> <li>• Piotrowski J., Podstawy Metrologii, PWN 1977</li> <li>• Piotrowski J., Podstawy miernictwa, WNT 2000</li> <li>• Parchański J., Miernictwo elektryczne i elektroniczne, WSP 1998</li> <li>• Jaworski J., Morawski R., Olędzki J., Wstęp do metrologii i techniki eksperymentu, WNT 1992</li> <li>• Piotrowski J., Podstawy metrologii, Politechnika Śląska 1971</li> <li>• Taylor J. R., Wstęp do analizy błędów pomiarowych, PWN 1999</li> <li>• Tumański S., Technika pomiarowa, WNT 2007</li> <li>• Chwałeba A., Poniński M., Siedlecki A., Metrologia elektryczna, WNT 2009</li> </ul>
	Supplementary literature	<ul style="list-style-type: none"> <li>• Domańska A., Barzykowski J., Kujawińska M., <i>Współczesna metrologia wybrane zagadnienia</i>, WNT 2016</li> <li>• Jakubiec W., Malinowski J., <i>Metrologia wielkości geometrycznych</i>, PWN 2018</li> <li>• Bewoor A. K., Kulkarni V. A., <i>Metrology &amp; Measurements</i>, Tata McGraw-Hill Education 2009 (dostępna częściowo w books.google)</li> <li>• Banerjee G. K., <i>Electrical And Electronic Measurements</i>, PHI Learning Pvt. Ltd (books.google)</li> </ul>
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	