GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Metrology, PG_00047552		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2020/2021
Education level	first-cycle studies	Subject group	Obligatory subject group 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	

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

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	Zna budowę oraz właściwości metrologiczne przyrządów do pomiaru podstawowych wielkości elektrycznych. Zna zasady działania przetworników analogowo/cyfrowych. Zna metody konstruowania systemów pomiarowych.	[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	Knows basic metrology terms. Knows the methods of measurement. Strictly defines the measurand (menzurand). Presents the results of measurements according to the recommendations of the International System of Units SI, using correct designations and prefixes to form multiple and aliquot units of measurement. Analyses systematic errors in direct and indirect measurements. Knows the causes of measurement uncertainty and how to minimise it during measurement. Evaluates the uncertainty of Type A and Type B methods of measurement.	[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.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">No requirements</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>Colloquium</td><td>50.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">1. Dusza J. : Podstawy miernictwa. OWPW, Warszawa 2002. 2. Lisowski M.: Podstawy metrologii, OWPW, Wrocław 2011. 3. Tumański S.: Technika pomiarowa, WNT, Warszawa 2007. 4. Kamieniecki A.: Współczesny oscyloskop. Budowa i pomiary, Wydawnictwo btc, Legionowo 2009. 5. Stabrowski M. : Cyfrowe przyrządy pomiarowe. Wyd. Naukowe PWN, Warszawa 2002. 6. Zięba A.: Analiza danych w naukach ścisłych i technice, PWN, Warszawa 2013.</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">No requirements</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">1 Two voltmeters could be used to measure the voltage U = 12 V. The first was a class 0.5 laboratory voltmeter with a measuring range of 60 V, and the second was a class 1.5 blackboard voltmeter with a measuring range of 15 V. Which voltmeter allowed the voltage value to be determined with less error?2) What is the measured frequency if 3587 pulses were counted in the 10 ms gate-opening time of the frequency meter.3. a frequency meter, normally operating with an internal reference frequency source of 1 MHz, was used with an external reference generator of 4 MHz. How should the frequency measurement results be corrected: (a) multiply by 4, (b) multiply by 2, (c) divide by 4.4. represent in the figure the voltage waveform that occurs at the output of the integrator in an A/D converter with double integration processing. Mark with "a" the time interval in which the reference voltage is integrated, with "b" the time interval in which the measured voltage is integrated, with "c" the time interval proportional to the measured voltage, with "d" the moment when the state of the comparator output changes, with "e" the moment when the counter overflows, with "f" the time interval which is to be equal to 20 ms to ensure immunity of the converter to mains frequency interference.The Y channel of the oscilloscope has a bandwidth of 40 MHz. What is the rise time of the step response of the oscilloscope. What is the rise time of the pulse you will read from the screen of this oscilloscope if you are testing a pulse whose rise time is 20 ns.6. The uncertainty of the voltage measurement is expressed in the multimeter specification as ±(1%+2 digits) and the reading is 1.200 V. Calculate the uncertainty of the voltage measurement.7 Explain the meaning of the abbreviations read from the face plate of the multimeter: AC, DC, 2W, 4W.8. Express the voltage ratios in dB: U1/U2 = 103, 1, 10-2.9. give the rms and peak-to-peak value of the voltage in a domestic power network.10. Why is a four-wire connection between a resistor and a measuring instrument used when measuring small resistances?</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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