

FACULTY Electronics**SUBJECT CARD**

Name of subject in Polish: **Metrologia**
 Name of subject in English: **Metrology**
 Main field of study (if applicable): **Electronic and Computer Engineering**
 Specialization (if applicable):
 Profile: **academic**
 Level and form of studies: **1 st level/ full-time**
 Kind of subject: **obligatory**
 Subject code: **ECEA00001**
 Group of courses: **YES**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15	30		
Number of hours of total student workload (CNPS)	60	30	30		
Form of crediting	Crediting with grade	Crediting with grade	Crediting with grade		
For group of courses mark (X) final course	X				
Number of ECTS points	4				
including number of ECTS points for practical (P) classes		1	2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,5	0,5	1		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**SUBJECT OBJECTIVES**

- C1 – Acquiring knowledge in the field of measurement theory
- C2 – Acquiring on techniques of electrical and nonelectrical quantities measurements
- C3 – Acquiring knowledge and skills in measurement results analysis
- C4 – Acquisition of skills in measurements planning and performing
- C5 – Acquisition of skills in preparing reports on performed measurements

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

- PEU_W01 – interprets basic concepts in the field of metrology
- PEU_W02 – explains methods of measurement results analysis
- PEU_W03 – describes construction and operation of measuring devices
- PEU_W04 – characterises measurements of electrical quantities
- PEU_W05 – characterises measurements of nonelectrical quantities

relating to skills:

- PEU_U01 – knows applications and can use and maintenance measurement devices
- PEU_U02 – can design and perform measurements of basic electrical quantities
- PEU_U03 – can apply basic laws and theorems to measurement circuits
- PEU_U04 – can analyse measurement results and point to possible sources of errors
- PEU_U05 – can draw up a protocol and prepare a report on performed measurements

PROGRAMME CONTENT

Lecture		Number of hours
Lec1	Introduction to metrology	1
Lec2	Measurement units and systems, standards of electrical quantities, frequency and time	2
Lec3	Direct and indirect measurement methods	1
Lec4	Measurement accuracy and approaches to its assessment	2
Lec5	Methods for the analysis of measurement results	1
Lec6	General characteristics of measurement devices; construction and operation of analog meters	1
Lec7	Construction and operation of digital and microprocessor-based meters	1
Lec8	Measurements of constant electrical quantities	1
Lec9	Measurements of signal parameters	1
Lec10	Measurements of time-variable electrical quantities	1
Lec11	Measurements of electrical impedance	1
Lec12	Principles of nonelectrical quantities measurement	1
Lec13	Summing-up knowledge on metrology	1
	Total hours	15

Classes

Classes		Number of hours
Cl1	Organization of classes	1
Cl2	Basic laws and theorems of electrical circuits	4
Cl3	Limiting errors of direct measurement	2
Cl4	Analysis of measurement of voltage and current	2
Cl5	Limiting errors of indirect measurement	2
Cl6	Analysis of measurement of electrical resistance	2
Cl7	Summing-up skills	2
	Total hours	15

Laboratory		Number of hours
Lab1	laboratory organization and safety regulations	3
Lab2	Measurement devices – maintenance and using	3
Lab3	Oscilloscope - principle of operation, maintenance and using	3
Lab4	DC voltage measurements	3
Lab5	DC current measurements	3
Lab6	Measurements of electrical resistance	3
Lab7	Measurements of the voltage and current source parameters	3
Lab8	RMS voltage measurement of periodic signals	3
Lab9	Measurements of frequency and phase of periodic signals	3
Lab10	Reserve term / own work	3
	Total hours	30

TEACHING TOOLS USED
N1. Traditional lectures with the use of multimedia presentations N2. Written instructions for the classes N3. Discussion on solved problems N4. Short tests of preparation to classes N5. Preparing protocols and reports on performed measurements N6. Individual consultations N7. Own work

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01 – PEU_W05	Final test
F2	PEU_U03, PEU_U04	Short tests, discussions, final test
F3	PEU_U01, PEU_U02, PEU_U05	Short tests, discussions, protocols and reports
C = (F1 + F2 + F3)/3 (positive grade under condition: F1>2 & F2>2 & F3>2)		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE:</u> [1] Czichos H., Saito T., Smith L.E.: Springer Handbook of Metrology and Testing. Springer-Verlag, Berlin Haidelberg, 2011. [2] Bucher J.L. (ed.): The Metrology Handbook (2nd Edition), Quality Press, Milwaukee, WI 2012. [3] Webster J.G. (ed.): Measurement, Instrumentation and Sensors Handbook. CRC Press LLC, Boca Raton 1999. [4] Guide to the Expression of Uncertainty in Measurement. ISO/IEC Guide 98-3:2008. <u>SECONDARY LITERATURE:</u> [1] Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna. WNT, Warszawa 2003. [2] Sydenham P.H. (ed.): Handbook of Measurements, vol. 1&2. John Wiley & Sons Ltd., Chichester 1982. [3] Tumański S.: Technika pomiarowa. WNT, Warszawa 2007-2013.
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