FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Miernictwo elektryczne 2**
Name in English:	**Electrical Metrology 2**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, part-time**
Kind of subject:	**obligatory**
Subject code:	**ELR043373**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	20		10		
Number of hours of total student workload (CNPS):	54		27		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of basic mathematical operations, functions properties (trigonometric, exponential, logarithmic, and inverse to them), indefinite integral calculus of one variable functions.
2. Has a basic knowledge of the electrical metrology and measurement units. Knows measurement properties of basic metrological tools, knows bidge circuits. Has a knowledge of calculation methods used to measurement result calculations.

SUBJECT OBJECTIVES

C1. Familiarize student with a knowledge of: analogue instruments to measure mean nad RMS value of currents and voltages, bridge measurement circuits, measure active and reactive power three-phase lines alternating current, using intrument transformers and standard transducers in high-voltage power lines, reactive power measurements.

C2. Awareness student possibility of measurement methods using in measurement technique, measurement circuits metrological analysis.

C3. Skills sophistication of correctly writing measurement results in used measurement systems in range of basic electrical quantities measures.

C4. Skills sophistication of electric circuits connection, current, voltage and power measurements using analogue and digital instruments and oscilloscope.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01	Has knowledge of moving coil meters, moving iron meters, electrodynamic meters and knows measurement circuits using these instruments.
PEK_W02	Has a knowledge of the resistance and impedance measurements and its components using the deflection and zero method.
PEK_W03	Has a knowledge of measurement systems to measure active and reactive power single-phase and three-phase lines alternating current. Knows basis methods of current and voltage processing and knows measurement circuits to measure active power in high-voltage lines.

relating to skills:

PEK_U01	Be able to measure current and voltage using analog and digital instruments and osciloscope. Knows how to calculate a measurement result using uncertainty theory.
PEK_U02	Be able to choose the correct measurement circuit to measure quantities by technical method. Can measure the resistance using digital ohmmeters.

relating to social competences:

PEK_K01	Understands the need to work in a team, is aware of the responsibility for the work.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Analogue meters. Moving-coils meters and extending ranges. Mean and RMS value measurements of sinusoidal signals.	2
Lec 2	Technical method of resistance measurement. Moving-iron instruments.	2
Lec 3	Moving-iron, electrodynamic and ferrodymamic instruments. RMS value convertrers.	2
Lec 4	Resistance measurements using analog and digital meters and bridges. Wheatstone and Thomson bridge.	2
Lec 5	Impedance measurements using AC bridges. Wien, Maxwell-Wien, Schering and transformer bridge.	2
Lec 6	One-phase circuit power measurement – elimination of method error.	2
Lec 7	Three-phase power measurement using one, two or three wattmeters.	2
Lec 8	Single and three-phase reactive power measurements. Voltage and current instrument transformers and normalizing transducers.	2
Lec 9	Active power measurements in high voltage semi-indirect and indirect systems.	2
Lec 10	Test.	2
	Total hours:	**20**

Form of classes - laboratory		**Number of hours:**
Lab 1	Presentation the Procedure Health and Safety Rules and Laboratory Rules. Establish rules for passing. Rounding of the measurement results rules presentation. Learning writing the measurement results.	2
Lab 2	Voltage and current measurements using analogue and digital meters. Absolute and relative errors determination. Measurement result uncertainty calculation.	2
Lab 3	Sinusoidal and distorted signals measures generated from function generator using oscilloscope.	2
Lab 4	Resistance measurements using multimeter and circuits realizing technical method. Correct measurement circuit selection, assessing method errors and measurement result uncertainty calculation.	2
Lab 5	Assessment and complement laboratory arreas.	2
	Total hours:	**10**

TEACHING TOOLS USED
N1. Traditional lecture, multimedia presentations.
N2. Check knowledge in oral and writing answer form, report preparation, office hours.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEK_W01 PEK_W02 PEK_W03	Test
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02	Check preparation to laboratory.
F2(L)	PEK_U01 PEK_U02 PEK_K01	Activity.
F3(L)	PEK_U01 PEK_U02	Report.
P(L)	P=0,3F1+0,1F2+0,6F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Chwaleba A., Poniński M., Siedlecki A., Metrologia elektryczna, WNT, Warszawa 2010.
[2] Miernictwo elektryczne – ćwiczenia laboratoryjne, praca zbiorowa pod redakcją D. Koczeli, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2001
[3] Tumański S., Technika pomiarowa, WNT, Warszawa, 2007
[4] Piotrowski J., Podstawy metrologii, WNT, Warszawa, 2003
[5] Czajewski J., Podstawy metrologii elektrycznej, OW Pol. Warszawskiej, Warszawa, 2008
[6] www.imnipe.pwr.edu.pl

SECONDARY LITERATURE:

[1] Kwiatkowski W.: Miernictwo elektryczne. Analogowa technika pomiarowa, OW Pol. Warszawskiej, Warszawa, 1998
[2] Lisowski M., Podstawy metrologii, Of. Wyd. Pol. Wrocławskiej, Wrocław, 2011
[3] Marcyniuk A., Pasecki E., Pluciński M., Szadkowski B., Podstawy Metrologii Elektrycznej, Warszawa, WNT, 1984.
[4] Orzeszkowski Z.: Podstawy metrologii elektrycznej, Wyd. Pol. Wrocławskiej, Wrocław 1981.
[5] Szumielewicz B., Słomski B., Styburski W., Pomiary elektroniczne w technice, Warszawa, WNT, 1982.
[6] Badźmirowski K., Karkowska H., Karkowski Z., Cyfrowe systemy pomiarowe, Warszawa, WNT, 1979.

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR043373 - Electrical Metrology 2
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ETK_W22	C.1 C.2	Lec1 Lec2 Lec3	N.1
PEK_W02	K1ETK_W22	C.1 C.2	Lec4 Lec5	N.1
PEK_W03	K1ETK_W22	C.1 C.2	Lec6 Lec7 Lec8 Lec9	N.1
PEK_U01	K1ETK_U19	C.3 C.4	Lab1 Lab2 Lab3	N.2
PEK_U02	K1ETK_U19	C.3 C.4	Lab4	N.2
PEK_K01	K1ETK_K05	C.1 C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lab1 Lab2 Lab3 Lab4 Lab5	N.1 N.2