FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Miernictwo elektryczne 3**
Name in English:	**Electrical Metrology 3**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ELR053316**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):			30		
Number of hours of total student workload (CNPS):			60		
Form of crediting:			crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:			2		
including number of ECTS points for practical (P) classes :			2		
including number of ECTS points for direct teacher-student contact (BK) classes:			1.40		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Can correctly and effectively apply the knowledge of differential and integral calculus of one variable functions to the qualitative and quantitative analysis of the issues.
2. Can measure electrical quantities using analog and digital meters and oscilloscope. Can determine, on the measurements basis, the characteristics of nonlinear elements, present the results of measurements in the form: numerical, tabular and can draw the right conclusions.

SUBJECT OBJECTIVES

C1. Skills sophistication of uncertainty calculation and correct writing measurement result in used measurement circuits used to measure different electrical quantities.

C2. Connecting electric circuits practical skills acquisition, measuring uses bridges, measuring power in three-phase systems, high currents measurements, electrical sheets parameter measurements, the use of differential method.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

relating to skills:

PEU_U01 Can do measurements of chosen electrical quantities.

PEU_U02 Can analyze obtained measurement results.

relating to social competences:

PEU_K01 Understands the need to work in a team, is aware of the responsibility for the work.

PROGRAMME CONTENT		
Form of classes - laboratory		**Number of hours:**
Lab 1	Presentation the Procedure Health and Safety Rules and Laboratory Rules. Establish rules for passing. Uncertainty calculations in indirect measurements.	2
Lab 2	Single-phase active power measurements. Phase factor determination. Measurement result uncertainty calculation.	2
Lab 3	Three-phase active power measurements with possibility of high value current measurements. Phase factor determination. Measurement result uncertainty calculation.	2
Lab 4	Resistance measurements with using Wheatstone bridge. Measurement result of technical and laboratory bridge uncertainty calculation.	2
Lab 5	Direct measurements of RLC parameters. Get to know with two-elements substitute circuits and uncertainty calculations of chosen instruments.	2
Lab 6	Frequency and phase shift measurements using oscilloscope – time and ellipse method. Measurement result uncertainty calculation.	2
Lab 7	Voltage measurement using virtual instrument. Knowing measurement possibilities of basic virtual instrument to measure voltage signals basic parameters and its frequency spectrum.	2
Lab 8	DC voltage and current measurements. Method error calculation of voltage measurement using voltmeter, current using ammeter and assessing the impact of alternate component to measure DC voltage.	2
Lab 9	High value current measurements with using measurement tools: current instrument transformer, shunt, inductive transducer, clamp ammeter, Rogowski coil.	2
Lab 10	Three-phase reactive power measurements in three and four-wire power networks. Phase factor determination. Measurement result uncertainty calculation.	2
Lab 11	Small value resistance measurements. Calculation of measurement uncertainty.	2
Lab 12	Transformers ratio measurements using differential method and voltmeters. Measurement result uncertainty calculation.	2
Lab 13	Electrical sheet parameters measurements in circuit with Epstein instrument to determine, using static method, magnetization characteristic of electrical sheets.	2
Lab 14	Checking errors of basic instruments. Knowing measurement technique to testing electrical measurement equipment.	2
Lab 15	Assessment and complement laboratory arreas.	2
	Total hours:	**30**

TEACHING TOOLS USED
N1. Check knowledge in oral and writing answer form, report preparation, office hours.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(L)	PEU_U01 PEU_U02	Check preparation to laboratory.
F2(L)	PEU_U01 PEU_U02 PEU_K01	Activity.
F3(L)	PEU_U01 PEU_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] Derlecki S., Metrologia elektryczna i elektroniczna, Podręczniki Akademickie- Pol. Łódzka, 2010
[5] Kalus-Jęcek B., Wzorce wielkości elektrycznych i ocena niepewności pomiarów, Wyd. Pol. Łódzkiej, Łódź, 2000
[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] Czajewski J., Podstawy metrologii elektrycznej, OW Pol. Warszawskiej, Warszawa, 2008
[6] Piotrowski J., Podstawy miernictwa, WNT, 2003

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