

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: **ELR053373**
 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):	60		30		
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

- Has a basic knowledge of basic mathematical operations, functions properties (trigonometric, exponential, logarithmic, and inverse to them), indefinite integral calculus of one variable functions.
- Has a basic knowledge of the electrical metrology and measurement units. Knows measurement properties of basic metrological tools, knows bridge 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 and RMS value of currents and voltages, bridge measurement circuits, measure active and reactive power three-phase lines alternating current, using instrument 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 LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 Has knowledge of moving coil meters, moving iron meters, electrodynamic meters and knows measurement circuits using these instruments.
- PEU_W02 Has a knowledge of the resistance and impedance measurements and its components using the deflection and zero method.
- PEU_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:

- PEU_U01 Be able to measure current and voltage using analog and digital instruments and oscilloscope. Knows how to calculate a measurement result using uncertainty theory.
- PEU_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:

- PEU_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 ferrodynamic instruments. RMS value convertres.	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 arrears.	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 LEARNING OUTCOMES ACHIEVEMENT		
Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEU_W01 PEU_W02 PEU_W03	Test
P(W)	P=F1	
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:

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| <ul style="list-style-type: none">[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 |
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SECONDARY LITERATURE:

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| <ul style="list-style-type: none">[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. |
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SUBJECT SUPERVISOR

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