



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Podstawy metrologii [S1MNT1>PM]

### Course

Field of study

Mathematics of Modern Technologies

Year/Semester

2/3

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

### Number of hours

Lecture

15

Laboratory classes

30

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

### Number of credit points

3,00

### Coordinators

dr inż. Zbigniew Krawiecki

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### Lecturers

### Prerequisites

Basic knowledge of mathematics, physics and electrical engineering. Ability to effectively self-educate in a field related to the chosen field of study. Awareness of the need to expand knowledge and skills. Ability to submit to the rules of the university process of studying.

### Course objective

Getting to know the metrological and operational properties of the basic measurement tools and the rules of elaborating the measurement results. Developing the ability to properly select measurement methods and devices for the implementation of measurement engineering tasks.

### Course-related learning outcomes

Knowledge:

- the student has an organized knowledge of the classification of basic measurement methods and mathematical methods of determining measurement inaccuracies [K\_W08(P6S\_WG)];
- the student knows the principles of selecting the elements of a simple system for measuring and processing electrical signals [K\_W08(P6S\_WG)].

#### Skills:

- the student can make the correct selection of the method and measuring tools for the measurement of basic electrical quantities [K\_U09(P6S\_UW), K\_U13(P6S\_UW)];
- the student is able to plan and carry out a simple measurement engineering task with the use of a measuring system [K\_U12(P6S\_UW), K\_U13(P6S\_UW)];
- the student is able to use the technical documentation of the instrument and other industry materials as well as the current state of knowledge to develop and critically assess the quality of measurement results [K\_U11(P6S\_UW), K\_U12(P6S\_UW)];
- the student knows how to use measuring instruments in accordance with the principles of health and safety at work [K\_U11(P6S\_UW)].

#### Social competences:

- the student is aware of the limitations of his knowledge and the need to constantly improve it [K\_K01(P6S\_KK), K\_K02(P6S\_KK)];
- the student is able to think and act creatively and responsibly [K\_K03(P6S\_KO)].

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: assessment of the knowledge shown in the final test (test, accounting and problem questions, 50% pass threshold), rewarding activity in the classroom;

Laboratory classes: assessment of knowledge and skills related to the implementation of a laboratory task, assessment of the report made in class or at home. Rewarding insights regarding the improvement of the content of teaching materials.

### Programme content

Lectures: basic concepts in metrology, measuring instruments and methods, measurement inaccuracy, planning of a measurement task, direct and indirect measurement of electrical quantities, multiple measurements, oscilloscope measurements, introduction to computer-controlled measurement systems;

Laboratory: learning how to use the basic equipment used during laboratory classes, measuring: voltage, current, resistance, capacitance, frequency, period, phase shift between signals, determining inaccuracies in measurements, preparing the measurement result.

### Course topics

Lectures: basic terminology in metrology, instruments and methods for measuring basic electrical quantities, measuring transducers, measurement error, planning a measurement task, direct and indirect measurement of an electrical quantity, multiple measurements (statistical calculations), RMS voltage measurement of sinusoidal and non-sinusoidal waveforms, resistance measurement, capacitance, frequency, power, digital oscilloscope - configuration and measurements of electrical quantities; introduction to measuring systems with computer control;

Laboratory classes: measurements with equipment used in laboratory classes: multimeter, generator, digital oscilloscope, power supply, configuration of instruments, measurement of: voltage, current, resistance, capacity, direct and indirect measurements with instruments, calculation of errors in direct and indirect measurements, preparation of the measurement result, digital oscilloscope measurements, measurement of peak-to-peak value, amplitude, frequency, period, time and phase shift between signals, recording of results.

### Teaching methods

Lectures: lecture with a multimedia presentation supplemented with examples given on the blackboard, initiating discussions related to issues, referring to the curriculum content of other subjects;

Laboratory classes: individual or team work, discussion of various methods and aspects of problem solving. Detailed review of the documentation from the laboratory by the teacher.

### Bibliography

#### Basic:

- Chwaleba A., Poniński M., Siedlecki A., Metrologia elektryczna, WNT, Warszawa, 2010;
- Cysewska-Sobusiak A., Podstawy metrologii i inżynierii pomiarowej, Wyd. Politechniki Poznańskiej,

2010;

- Dusza J., Gortat G., Leśniewski A., Podstawy miernictwa, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007;
- Rydzewski J., Pomiar oscyloskopowe, WNT, Warszawa, 2007;
- Tumański S., Technika pomiarowa, WNT 2007;
- Nawrocki W., Rozproszone systemy pomiarowe, WKiŁ, Warszawa, 2006;
- Krawiecki Z., Odon A.: Wspomagane komputerowo stanowisko laboratoryjne do badania właściwości metrologicznych multimetrów na zakresach napięć przemiennych, Pomiary Automatyka Kontrola, 2007, vol. 53, nr 9 bis, s. 710-712

Additional:

- Międzynarodowy Słownik Podstawowych i Ogólnych Terminów Metrologii, Wydanie polskie, Główny Urząd Miar, Warszawa, 1996;
- Zatorski A., Sroka R., Podstawy metrologii elektrycznej, Wyd. AGH, Kraków 2011.

### Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00