



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Fundamentals of metrology [S1IMat1>PM]

### Course

Field of study

Materials Engineering

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

15

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

### Number of credit points

2,00

### Coordinators

dr inż. Karol Grochalski

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### Lecturers

### Prerequisites

Basic knowledge of analysis and mathematical statistics, basic knowledge of experimental physics.

### Course objective

Getting to know the basics of metrology, the characteristics of standards and measuring tools. Acquiring knowledge about the methods and principles of measuring selected geometric quantities and the ability to use measuring equipment. Gaining knowledge about measurement methods, error calculus and calculating the uncertainty of direct and indirect measurement.

### Course-related learning outcomes

Knowledge:

1. the student knows the si system of measurement units [k\_w02, k\_w11, k\_w17].
2. the student knows the definitions and classification of particular types of errors, their elimination or estimation [k\_w01, k\_w11, k\_w17].
3. the student knows the statistical methods of elaborating the measurement results [k\_w01, k\_w11, k\_w17].
4. the student knows the basic measuring equipment used to measure machine parts [k\_w11, k\_w17].

#### Skills:

1. the student can perform an operation check of the measuring instrument according to the instructions - [k\_u09]
2. the student is able to calculate the value of indirect measurement uncertainty - [k\_u09]
3. the student is able to determine the measurement uncertainty of the instrument using the a and b methods - [k\_u09]

#### Social competences:

1. is aware of the importance of carrying out the correct measurement of machine parts - [k\_k02]
2. understanding the requirement of learning by whole life; ability to inspire and organize learning process of other people. - [k\_k01]

methods for verifying learning outcomes and assessment criteria learning

outcomes presented above are verified as follows:

lecture: credit on the basis of a test consisting of questions and tasks conducted at the last lecture in the semester. passing threshold: 51% of points

laboratory: passing on the basis of an oral or written answer regarding the content of each exercise and the grades obtained from the reports. in order to pass the laboratory all exercises must be passed.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

empty

### Programme content

#### Lecture:

1. Measurement theory, measurement, its essence, measurement result, methods, principles and methods of measurement.
2. Measurement errors, definition and classification, systematic errors, random errors and excessive errors.
3. Statistical analysis of the measurement results. Determining the measurement uncertainty with methods A and B.
4. Measuring tools, their division and characteristics.
5. Measurement methods, direct and indirect methods.
6. Determining fits and tolerances of machine parts.
7. Checking measuring tools for measuring geometrical quantities.

#### Laboratory:

1. Checking of measuring instruments.
2. Indirect measurements - uncertainty of indirect measurements.
3. Contact measurements of threads.
4. Error analysis, statistical processing of measurement results.
5. Measurements of gears.
6. Measurements of external and internal dimensions.

### Teaching methods

Lecture: multimedia presentation, illustrated with examples given on the board.

Laboratory: conducting experiments, solving problems, discussion.

### Bibliography

#### Basic

1. Jakubiec W., Malinowski J.: Metrologia wielkości geometrycznych, WNT, Warszawa, 2018
2. Paczyński Piotr: Metrologia techniczna. Przewodnik do wykładów ćwiczeń i laboratoriów. Wydawnictwo Politechniki Poznańskiej, Poznań, 2003
3. Zakrzewski J. Podstawy miernictwa dla kierunku mechanicznego, Wydawnictwo Politechniki Śląskiej, Gliwice, 2004
4. Arendarski J.: Niepewność pomiarów, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2013

#### Additional

1. Ifan Hughes, Thomas Hase: Measurements and their Uncertainties: A practical guide to modern error analysis, Oxford University Press, 2010
2. Connie L. Dotson: Fundamentals of Dimensional Metrology, Cengage Learning, 2014
3. Białas S, Humienny Z., Kiszka K: Metrologia z podstawami specyfikacji geometrii wyrobów (GPS). Oficyna Wydawnicza Politechniki Warszawskiej, 2014

### Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	0,50