



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Basics of metrology [S1IBio1>PM]

### Course

Field of study

Biomedical 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

elective

### 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

### 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.
2. The student knows the definitions and classification of particular types of errors, their elimination or estimation.
3. The student knows the statistical methods of elaborating the measurement results.
4. The student knows the basic measuring equipment used to measure machine parts.

Skills:

1. The student can perform an operation check of the measuring instrument according to the

instructions.

2. The student is able to calculate the value of indirect measurement uncertainty.
3. The student is able to determine the measurement uncertainty of the instrument using the A and B methods.
4. The student is able to select a device for the measurement task to a basic level.

Social competences:

1. Is aware of the importance of carrying out the correct measurement of machine parts.
2. Understanding the requirement of learning by whole life; ability to inspire and organize learning process of other people.]

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Written credit. Pass threshold: 50% of the credits.

Laboratory: Credit based on the evaluation of the oral or written answers on the content of each exercise performed and the grades obtained from the reports. All exercises must be passed to receive credit for the laboratory.

### Programme content

Lecture

1. The theory of measurement, measurement, its essence, the result of measurement, methods, principles and ways of measurement.
2. SI system of units of measurement, definition of a metre. Measurement standards.
3. Measurement errors, definition and classification, systematic, accidental and excessive errors.
4. Uncertainty of measurement.
5. Tolerances and fits.
6. Tolerances of form, orientation, location and run-out.
7. Workshop measuring tools.
8. Coordinate measuring technology - introduction.

Laboratory:

1. Checking of measuring instruments.
2. Direct and indirect measurements. Determination of measurement uncertainty.
3. Measurements of external and internal dimensions. Tolerances and fits.
4. Contact measurements of threads.
5. Form error measurements.
6. Introduction to coordinate technology..

### 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. Arendarski J.: Niepewność pomiarów, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2013
4. Jakubiec W., Zator S., Majda P.: Metrologia, PWE 2014
5. Białas S., Humienny Z., Kiszka K.: Metrologia z podstawami specyfikacji geometrii wyrobów (GPS) WPW 2014
6. Ratajczyk E., Woźniak A.: Współrzędnościowe systemy pomiarowe, Warszawa 2016

Additional:

1. Ifan Hughes, Thomas Hase: Measurements and their Uncertainties: A practical guide to modern erroranalysis, Oxford University Press, 2010.
2. Connie L. Dotson: Fundamentals of Dimensional Metrology, Cengage Learning, 2014

3. Ratajczyk E.: Współrzędnościowa technika pomiarowa, Warszawa 2005.

4. Humienny Z., Osana P.H., Tamre M., Weckenmann A., Blunt L., Jakubiec W.: Specyfikacje geometrii wyrobów (GPS), podręcznik europejski, WNT, Warszawa 2004.

### Breakdown of average student's workload

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