



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Metrology [S1Lot1-SLiPL>MW]

### Course

Field of study

Aviation

Year/Semester

2/4

Area of study (specialization)

Aircraft Engines and Airframes

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. Michał Jakubowicz

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### Lecturers

### Prerequisites

Students beginning this subject should have knowledge of mathematical analysis and statistics, technical drawing and machine parts.

### Course objective

Learning the basic concepts of measurement techniques. Getting to know the measuring instruments and methods used in machine construction. Acquiring the ability to calculate and select the tolerance and fit symbol for holes, shafts and threads. Acquiring knowledge about measurement methods, error calculation and calculation of uncertainty of direct and indirect measurement

### Course-related learning outcomes

Knowledge:

1. has ordered and theoretically founded general knowledge in the field of key technical issues and detailed knowledge of selected issues related to air transport, knows the basic techniques, methods and tools used in the process of solving tasks related to air transport, mainly of an engineering nature  
has knowledge of the method of presenting test results in the form of tables and graphs, performing the analysis of measurement uncertainties

3. has extended knowledge in the field of material strength, including the theory of elasticity and plasticity, stress hypotheses, methods of calculating beams, membranes, shafts, joints and other structural elements, as well as methods of testing the strength of materials and the state of deformation and stress in structures, and has basic knowledge of the main departments of technical mechanics: statics, kinematics and dynamics of a material point and a rigid body
4. has a basic knowledge of the mechanisms and laws governing human behavior and psyche

#### Skills:

1. is able to obtain information from various sources, including literature and databases, both in Polish and in English, integrate them properly, interpret them and make a critical evaluation, draw conclusions and exhaustively justify the opinions they formulate
2. is able to properly plan and perform experiments, including measurements and computer simulations, interpret the obtained results, and correctly draw conclusions from them

#### Social competences:

1. understands that in technology, knowledge and skills very quickly become obsolete
2. is aware of the social role of a technical university graduate, in particular understands the need to formulate and provide the society, in an appropriate form, with information and opinions on engineering activities, technological achievements, as well as the achievements and traditions of the engineer profession

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Passing on the basis of a colloquium consisting of 2 general and 3 specific questions or a selection test consisting of 10 to 40 open as well as closed questions, conducted at the end of the semester

Laboratory: Passed on the basis of a written answer in the scope of content. Performed the laboratory exercises according to the program established by the teacher with a positive grade of the reports on the six exercises prepared according to the subject matter. In order to get a credit for the laboratories, all exercises must be passed.

### Programme content

The program includes learning the basic concepts of metrology and measurement systems. Learning about measuring instruments used in mechanical engineering.

### Course topics

Lecture: Measurement theory, measurement and its essence, measurement result, methods, types and means of measurement, SI units, meter definition, length and angle standards, gauge blocks, angle blocks, bevels, standards hierarchy, measurement errors, definition and classification, systematic, random and gross errors, error estimation and elimination of outliers, estimation of measurement uncertainty, measuring tools - classification, measurement methods, direct and indirect methods, errors in indirect methods, caliper devices, micrometer devices, indicators, tolerances and fits, form, location and run-out tolerances, surface roughness measurements, basics of coordinate measurement.

PART - 66 (THEORY - 11.25 hours, PRACTICE 11.25 hours)

#### MODULE 7A. MAINTENANCE ACTIVITIES

##### 7.3 Tools

Types of common hand tools;

Types of common electric tools;

Operation and use, precision measurement tools;

Lubrication devices and methods

Operation, function and use of electrical general test equipment; [3]

Laboratory :

1. Indirect Measurements.
2. Statistical analysis of measurement results.
3. Inside and outside measurements.
4. Measurement of threads.
5. Measurement of gears.

## 6. Measurement of form deviations.

### Teaching methods

1. Lecture: multimedia presentation, illustrated with examples given on the board.
2. Laboratory exercises: performing the tasks given by the teacher - practical exercises

### Bibliography

#### Basic

1. Adamczak S., Pomiary geometryczne powierzchni: zarysy kształtu, falistość i chropowatość, WNT, Warszawa, 2008.
2. Adamczak S., Makiela W., Podstawy Metrologii i inżynierii jakości dla mechaników, WNT, Warszawa, 2010.
3. Arendarski J., Niepewność pomiarów, Wyd. OWPW, Warszawa, 2013.
4. Białas S., Humienny Z., Kiszka K., Metrologia z podstawami specyfikacji geometrii wyrobów (GPS), Wyd. OWPW, Warszawa, 2014.
5. Jakubiec W., Malinowski J., Metrologia wielkości geometrycznych, WNT, Warszawa, 2018.
6. Jakubiec W., Zator S., Majda P., Metrologia, PWE, Warszawa, 2014.
7. Jezierski J., Analiza tolerancji i niedokładności pomiarów w budowie maszyn, WNT, Warszawa, 1994.
8. Paczyński P., Metrologia techniczna. Przewodnik do wykładów, ćwiczeń i laboratoriów, Wyd. PP, Poznań, 2003.
9. Zawada J., Metrologia wielkości geometrycznych, Wyd. Politechniki Łódzkiej, Łódź, 2011.
10. Zięba A., Analiza danych pomiarowych w naukach ścisłych i technice, Wyd. PWN. Warszawa, 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