

# Course description

## 1 General information

Course name	In-process metrology
Course code	
Level of study (B.Sc, M.Sc., Ph.D.)	M.Sc.
ECTS	5
Course manager	dr hab inż. Adam Gąska, prof. PK, Laboratory of Coordinate Metrology, M-10, adam.gaska@pk.edu.pl
Course length	One (1) semester
Coordinator for international programs	<a href="mailto:erasmus@mech.pk.edu.pl">erasmus@mech.pk.edu.pl</a>

## 2 Prerequisites

- knowledge of basics of metrology

## 3 Program

Type	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	30	0	15	0	15	0

## 4 Contents

Lectures		
No.		Hours
1	Definition of basic concepts related to in-process metrology. Objectives of in-process metrology application and related economic benefits.	3
2	Types of in-process control: in-process metrology, in-situ metrology, in-line metrology. Characteristics of each type of control.	3
3	Principles of replacing conventional methods of metrological control with methods of in-process control.	2
4	Speed, acceleration, force and stress sensors.	4
5	Position and displacement measuring systems (linear and rotational).	3
6	Sensors implementing the sense of touch.	2
7	Sensors implementing the sense of sight.	3
8	On-line correction of the accuracy of machines and technological devices, correction of geometric errors of linear and rotary axes.	4
9	Issues related to in-process metrology in the context of work safety rules and the CE mark.	3
10	Selected examples of practical applications of in-process metrology solutions.	3

Labs		
No.		Hours
1	Installation of the stand for the control of linear and angular displacement systems used in technological devices.	3
2	Installation of selected position and displacement sensors on the test stand and	3

	implementation of on-line control of these parameters.	
3	Use of information from position and displacement sensors to improve the geometric accuracy of displacement systems.	3
4	Optical and tactile control systems for verification of geometric product specifications used on production lines on the example of a demonstration production line or a selected CNC center.	3
5	Use of optical systems to control selected geometric parameters of products on a demonstration production line or a selected CNC center.	3

<b>Project</b>		
No.		Hours
1	Analysis of a selected task related to the use of in-process metrology. Classification of solutions of in-process metrology systems planned to be used and analysis of the possibility of applying an appropriate type of in-process control.	3
2	Selection of appropriate practical solutions for the selected in-process metrology task.	3
3	Selection of sensors implementing senses of touch and sight for the selected task.	3
4	Application of velocity, force and stress sensors for the selected task.	3
5	Analysis of the safety aspects of the application of selected in-process control systems.	3

## **5 Learning Outcomes (skills and knowledge):**

- The student is able to define the types of in-process control.
- The student can name and distinguish position, displacement, speed, acceleration, force and stress sensors.
- The student understand different principles of working of senses of touch and sight sensors.
- The student can operate basic optical and tactile control systems for verification of geometric product specifications.
- The student know safety rules related to application of in-process control systems.

## **6 Assessment policy (examination):**

- Passed theoretical (lecture) exam
- Passed laboratory test and provided all reports
- Finished group projects
- The final grade is evaluated as the weighted average of grades from: the theoretical exam (0.4), the laboratory tests (0.3) and group projects (0.3)

## **7 Literature**

1. Graham T. Smith — Machine Tool Metrology. An Industrial Handbook, Springer, 2016.
2. Robert J. Hocken, Paulo H. Pereira — Coordinate Measuring Machines and Systems, CRC Press, 2017.
3. Wei Gao, Metrology, Springer Nature, 2019.