COURSE SPECIFICATION

Course code	full-time programme:	**M#2-S1-ME-404**
	part-time programme:	
Course title in Polish	**Metrologia**	
Course title in English	**Metrology**	
Valid from (academic year)	**2024/2025**	

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**first-cycle**
Type of education	**academic**
Mode of study	**full-time programme**
Specialism	**all**
Department responsible	**Department of Metrology and Modern Manufacturing**
Course leader	**dr hab. inż. Krzysztof Stępień, prof. PŚk** **dr hab. inż. Paweł Zmarzły, prof. PŚk**
Approved by	**dr hab. Jakub Takosoglu, prof. PŚk, Dean of the Faculty of Mechatronics and Mechanical Engineering**

COURSE OVERVIEW

Course type		**programme-specific**
Course status		**compulsory**
Language of instruction		**English**
Semester of delivery	full-time programme	**Semester IV**
	part-time programme	
Pre-requisites		**Fundamentals of metrology**
Examination required (YES/NO)		**YES**
ECTS value		**4**

Mode of instruction		**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	full-time programme	**15**	**15**	**15**		
	part-time programme					

LEARNING OUTCOMES

Category of outcome	**Outcome code**	**Course learning outcomes**	**Corresponding programme outcome code**

Knowledge	W01	Students have a structured advanced knowledge of probability theory and mathematical statistics applicable to the calculus of measurement errors. They know mathematical methods for assessing the parameters of the distribution of a random variable and developing an uncertainty budget.	MiBM1_W01 MiBM1_W12
	W02	Students have advanced knowledge of the physical principles used in the measurement of geometric quantities using measurement systems.	MiBM1_W02 MiBM1_W12
	W03	Students have advanced methods of measuring surface roughness. They have advanced knowledge of the interpretation of surface roughness parameters.	MiBM1_W12
Skills	U01	Students can use the knowledge of basic concepts in the field of mathematical analysis and statistics to determine measurement errors. They can calculate and select tolerances and fits.	MiBM1_U01 MiBM1_U12
	U02	Students know the principles of selecting measuring instruments for specific measurement tasks. They can use advanced measurement systems applied to evaluate geometric quantities in mechanical engineering. They can interpret measurement results	MiBM1_U01 MiBM1_U12
Competence	K01	Students are aware of the need to independently supplement and expand their knowledge in the field of metrology of geometric quantities used in mechanical engineering.	MiBM1_K03

COURSE CONTENT

Type of instruction lecture	Topics covered
lecture	Tolerances and fits. Problems of probability theory and mathematical statistics used in metrology of geometric quantities. Measurement uncertainty budget. Normal distribution and distribution parameters of a random variable. Characteristics of geometric deviations and methods of their measurement. Length and angle measurements using contact and optical methods. Surface texture measurements. Coordinate metrology.
class	Basics and principles of selection and calculation of tolerances and fits. Measurement error calculation. Evaluation of random variable distribution parameters. Methods of determining simple and complex measurement uncertainty.
laboratory	Measurements of thread and gear parameters. Optical measurements of selected geometric features. Measurements of roundness and cylindrical deviations. Straightness and flatness measurements. Roughness measurements using contact measuring instruments. Surface topography measurements. Coordinate measuring machine measurements.

ASSESSMENT METHODS

Outcome code	Methods of assessment *(Mark with an X where applicable)*					
	Oral examination	Written examination	Test	Project	Report	Other
W01		X				

W02		X				
W03		X				
U01			X		X	
U02			X		X	
K01						X

ASSESSMENT TYPE AND CRITERIA

Mode of instruction	Assessment type	Assessment criteria
lecture	examination assessment	Passing the exam. Scoring at least 50% of the points.
class	non-examination assessment	Obtaining at least 50% of points in the final test.
laboratory	non-examination assessment	Positive completion of class reports. Obtaining at least 50% of points in the final test.

OVERALL STUDENT WORKLOAD

ECTS weighting												
No.	Activity type	Student workload										Unit
		full-time programme					part-time programme					
1.	Scheduled contact hours	L	C	Lb	P	S	L	C	Lb	P	S	h
		15	15	15								
2.	Other contact hours (office hours, examination)	4	2	2								h
3.	**Total number of contact hours**	**53**										h
4.	**Number of ECTS credits for contact hours**	**2,1**										ECTS
5.	**Number of independent study hours**	**47**										h
6.	**Number of ECTS credits for independent study hours**	**1,9**										ECTS
7.	**Number of practical hours**	**67**										h
8.	**Number of ECTS credits for practical hours**	**2,7**										ECTS
9.	**Total study time**	**100**										h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**4**										ECTS

READING LIST

1. Adamczak S., Metrologia geometryczna powierzchni technologicznych, Wydawnictwo Naukowe PWN, Warszawa, 2023.
2. Kiszka K., Białas S., Humienny Z., Metrologia z podstawami specyfikacji geometrii wyrobów (GPS), Oficyna Wydawnicza Politechniki Warszawskiej, 2021.
3. Adamczak S., „Pomiary geometryczne powierzchni”, WNT, 2009.

4. Adamczak S., Makieła W., Podstawy metrologii i inżynierii jakości dla mechaników – ćwiczenia praktyczne, PWN, Warszawa, 2010.
5. Adamczak S., Makieła W. „Metrologia w budowie maszyn – zadania z rozwiązaniami, PWN, Warszawa, 2018.
6. Arendarski J., Niepewność pomiarów, Oficyna Wydawnicza Politechniki Warszawskiej, 2013.
7. Barzykowski, J., A. Domańska, M. Kujawińska, Współczesna metrologia – wybrane zagadnienia, WNT, Warszawa, 2016
8. Jakubiec W., Malinowski J., Metrologia Wielkości Geometrycznych, WNT, Warszawa, 2007.
9. Tumański S.: Technika pomiarowa. WNT, Warszawa, 2007
10. Ratajczyk E., Woźniak A., Współrzędnościowe systemy pomiarowe, Oficyna Wydawnicza Politechniki Warszawskiej, 2016.
11. Praca zbiorowa pod redakcją Z. Humiennego „Geometrical Product Specifications - Course for Technical Universities" – Oficyna Wydawnicza Politechniki Warszawskiej, 2001.
12. Katalog przyrządów pomiarowych 2019-2021 Mitutoyo - PL-20004.
13. Sarah H., The Metrology Handbook, States Academic Press, 2022.