

# SYLLABUS

## Course description

Course code		Course	SYSTEMY POMIAROWE I SZACOWANIE NIEPEWNOŚCI POMIARU		
MB/O/I/NST/C2A.6			MEASUREMENT SYSTEMS AND UNCERTAINTY ESTIMATION		
Language of instruction		English			
Academic year		2023/2024			
field of study:		Mechanical engineering			
field of specialisation:		Designing and Manufacturing of Machines			
Educational level		first-cycle studies			
Education profile		General academic			
Mode of study		Part-time studies			
Semester(s)		5			
Affiliation with a group of classes		Specialization module			
Course status		obligatory			
Types of classes, instruction hours, ECTS credits		Types of classes	Number of instruction hours	Number of ECTS credits	
		Lecture	8 [h]	2 ECTS	
		Classes	12 [h]		
Linkage of the course	with the education profile	Related to the conducted scientific activity in the discipline to which the field of study is assigned (general academic profile)			2 ECTS
	with qualifications	It is used by the student to acquire engineering competences			2 ECTS
	with science discipline	Mechanical engineering			2 ECTS
Form of teaching		Traditional – classes organized at the University /classes conducted using online learning methods and techniques			
Prerequisites		Qualification for the 5 <sup>th</sup> semester			
Department		Faculty of Mechanical Engineering			
Coordinator		dr hab. inż. Mirosław Rucki, prof. UTH Radom			
The website of the basic organizational unit		www.wm.uniwersytetradom.pl			
E-mail address, phone number of the coordinator		m.rucki@uthrad.pl; tel. 48 361 7696			

## LEARNING OUTCOMES, CURRICULUM CONTENT, TEACHING CLASSES, VERIFICATION OF LEARNING OUTCOMES

Learning Objective:	The objective is to acquire the ability of assessment of measuring system capacity, in particular, repeatability, reproducibility, and measurement uncertainty
Curriculum Content:	<p>The course is related to the conducted scientific activity.</p> <p><b>Lecture:</b> Measurement system in the context of Industry 4.0 concept. Robotization of measurement and measurement systems integrated with CPS (cyber-physical systems). Digitization of the measurement results and big data analysis. Measurement systems in the production processes. Optical scanning and processing of the 'cloud of points.' Visualization of the measurement results (deviations map). Multisensoric measurement systems. Multiscale measurement: nano-, micro-, and mezo-. 'Smart metrology,' monitoring and diagnosis in real time, and 'predictive' maintenance.</p> <p><b>Classes:</b> Estimation of measurement uncertainty using statistical methods (type A). Assessment of the influence of uncertainty sources on the result obtained from the measurement system (uncertainty type B). Calculation of the measurement tool (system) capacity. Assessment of the repeatability, reproducibility and stability of the measurement system.</p>
Didactic (educational) methods:	<p>Conventional lecture using audiovisual means, verbal problem method.</p> <p>Discussion and practical calculations.</p>
Course assessment type, the criteria for assessing the achieved learning outcomes, and the method of calculating the final grade:	<p>The assessment of the achieved learning outcomes will be made through written examination.</p> <p>The final grade from classes will be calculated on the basis of the completed tasks.</p>

Learning outcomes for the course in relation to the field of study learning outcomes and the type of classes				Methods of verifying learning outcomes	
Learning outcome number	Description of the learning outcomes for the course (PEU) A student who has passed the course ( W ) knows and understands / ( U ) can / ( K ) is ready to:	Field of study learning outcome (KEU)	Types of classes	Form of verification (credits)	Methods of testing and assessment
W1	achieved basic knowledge on metrology, understands methods of measurement of main parameters typical for the mechanical engineering	K_WG12	lecture/ classes	Exam	Written examination
W2	has basic knowledge on the trends in development of design, production, construction and maintenance of the machinery	K_WG14	lecture	Exam	Written examination
U1	is able to apply information technologies when solving engineering tasks on design, production and maintenance of machinery	K_UW05	classes	Completion of the tasks	Current assessment of the completed tasks
U2	is able to use measurement systems and methods of uncertainty estimation	K_UW06	lecture/ classes	Exam	Written examination
K1	is aware of the responsibility related to the decision-making in the frames of the engineering activities, especially in the area of personal safety and environmental protection	K_KO04	lecture	Exam	Written examination

Literature and teaching aids
1. Dietrich E., Schultze A.: Statistical Procedures for Machine and Process Qualification. Hanser, München 2010. 2. Dietrich E.: Measurement Process Qualification: Gage Acceptance and Measurement Uncertainty According to Current Standards. Hanser, München 2011. 3. Sydenham P.H., Thorn R. (Eds.): Handbook of Measuring System Design, 3 Volumes. Wiley 2005. 4. Webster J.G., Eren H. (Eds.): Measurement, Instrumentation, and Sensors Handbook. CRC Press 2014. 5. Bentley J.P.: Principles of measurement systems. Pearson Education, Essex 2005 Available online free <a href="https://uvceee.files.wordpress.com/2016/09/principles-of-measurement-systems-20051.pdf">https://uvceee.files.wordpress.com/2016/09/principles-of-measurement-systems-20051.pdf</a> 6. Measurement Uncertainty Analysis Principles and Methods: NASA Handbook. Available online free <a href="https://www.isobudgets.com/pdf/uncertainty-guides/nasa-hdbk-8739-19-3-nasa-measurement-quality-assurance-handbook-annex-3-measurement-uncertainty-analysis-principles-and-methods.pdf">https://www.isobudgets.com/pdf/uncertainty-guides/nasa-hdbk-8739-19-3-nasa-measurement-quality-assurance-handbook-annex-3-measurement-uncertainty-analysis-principles-and-methods.pdf</a>

Student workload required to achieve the assumed learning outcomes – the balance of ECTS credits			
Attendance, participation	Student workload [h].		
	Other contact hours (IGK)	Student's self-study hours Classes without a teacher (ZBN)	Classes
Participation in ... lectures	X	X	8 [h]
Participation in .... classes/laboratory classes	X	X	12[h]
Meeting with teachers during their duty hours	2 [h]	X	X
Preparation for lectures/classes/.... , Preparation for ... credit / exam	X	18 [h] 10 [h]	X
Total student workload	2 [h]/ 0.1 ECTS	28 [h]/ 1.1 ECTS	20[h]/ 0.8 ECTS
ECTS credits for the course	2 ECTS		

Additional information, comments
<p>In the case of students with special needs, including disabilities, and chronic illnesses, the methods and forms of verification of learning outcomes specified above (in the syllabus) are adapted to the individual needs of these students, as appropriate.</p> <p>Detailed rules and forms of support for students with special needs, including those with disabilities and chronically ill, during classes, credits, and exams are specified in: University Regulations (Regulamin Studiów Uniwersytetu Technologiczno-Humanistycznego w Radomiu), Study Regulations (Zasady Studiowania), and Procedure for Ensuring Accessibility of the Educational Process to Students with Special Needs, Including Those with Disabilities and Chronically ill (Procedura dotycząca zapewnienia dostępności procesu kształcenia studentom ze szczególnymi potrzebami, w tym: z niepełnosprawnością, przewlekle chorych).</p>

