COURSE SPECIFICATION

Course code	full-time programme:	**M#2-S1-ME-207A**
	part-time programme:	
Course title in Polish	**Mikro/nanotechnika**	
Course title in English	**Micro- and Nanotechnology**	
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 Maintenance, Laser and Nanoscale Technologies**
Course leader	**dr hab. inż. Monika Madej, 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		**elective**
Language of instruction		**English**
Semester of delivery	full-time programme	**Semester II**
	part-time programme	
Pre-requisites		
Examination required (YES/NO)		**NO**
ECTS value		**2**

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

LEARNING OUTCOMES

Category of outcome	Outcome code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	The student has knowledge in the field of mechatronics, electrical engineering, electronics, automation for formulating and solving simple technical problems	MiBM1_W04
	W02	The student has knowledge in the field of micro/nanotechnology: modern engineering materials, their research methods and application areas	MiBM1_W08 MiBM1_W10
	W03	The student has knowledge of surface engineering (including: modeling of the surface layer, assessment of the condition and durability of the surface and tribological tests).	MiBM1_W17
	W04	The student has the knowledge necessary to organize work in accordance with occupational health and safety regulations.	MiBM1_W19
Skills	U01	Student is able to use Polish and foreign-language literature, obtain knowledge from other sources and interpret it correctly.	MiBM1_U03
	U02	The student is able to use analytical and simulation methods to formulate and solve engineering tasks in the field of mechanics and machine construction.	MiBM1_U12
	U03	Student is able to measure basic geometric, mechanical and other quantities related to the process of manufacturing machine parts. Is able to analyze the obtained research results and formulate conclusions.	MiBM1_U11
	U04	Student is able to organize a workstation, operate instruments, devices and machines in accordance with applicable safety rules.	MiBM1_U11
	U05	The student understands the need to comply with health and safety rules. Able to work in a group and act in a creative and enterprising manner. Is able to plan and organize the work of himself and his team in an effective and safe manner.	MiBM1_U17 MiBM1_U20
Competence	K01	The student is ready to critically evaluate his knowledge. Understands the need to obtain new information both from literature and from experts in the field of mechanics and machine construction.	MiBM1_K01
	K02	The student is aware of the consequences of engineering activities, its impact on the environment, and the related responsibility for decisions made.	MiBM1_K02

COURSE CONTENT

Type of instruction lecture	Topics covered
lecture	The concept of micro/nanotechnology. Micro/nano devices (MEMS, NEMS) – structure, principles of operation and their application. Basics of adaptronics and biomimetics - application in innovative design of materials and devices. Biological micro/nanostructures, rotary and linear biological nanoengines. Technologies for producing nanostructures using vacuum methods - physical and chemical vapor deposition (PVD, PACVD). Devices for research on the micro/nano scale. Micro/nanotechnology in everyday life, research techniques and mechanics and machine construction. Development trends and positive and negative aspects of the use of micro/nanotechnology.
laboratory	Selection of micro and nanostructures depending on engineering applications. Production of nanostructures on microcircuits using vacuum methods - physical and chemical vapor deposition (CVD, PVD). Characterization of nano and microcircuits with coatings (chemical identification, imaging). Analysis of physicochemical properties - wettability, surface free energy. Assessment of the operational durability of coatings obtained using CVD and PVD methods.

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			
W04			x			
U01					x	
U02					x	
U03					x	
U04					x	
U05					x	
K01			x			
K02			x			

ASSESSMENT TYPE AND CRITERIA

Mode of instruction	Assessment type	Assessment criteria
lecture	non-examination assessment	The pass mark is a minimum of 50% for the final in-class test.
laboratory	non-examination assessment	The pass mark is a minimum of 50% for each in-class pre-lab test and each post-lab report.

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								
2.	Other contact hours (office hours, examination)	2		2								h
3.	**Total number of contact hours**	**34**										h
4.	**Number of ECTS credits for contact hours**	**1,4**										ECTS
5.	**Number of independent study hours**	**16**										h
6.	**Number of ECTS credits for independent study hours**	**0,6**										ECTS
7.	**Number of practical hours**	**25**										h
8.	**Number of ECTS credits for practical hours**	**1,0**										ECTS
9.	**Total study time**	**50**										h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**2**										ECTS

READING LIST

1. Dobrzański L.A.: Metalowe materiały inżynierskie, WNT, Warszawa 2004
2. Kelsall R.W., Hamley I.W., Geoghegan M.: Nanoscale Science and Technology, John Wiley & Sons Ltd, Chichester 2005.
3. Kapuścik A.: Produkcja w skali „nano". Inspektor Pracy 2006, 10, 11-13.
4. Praca zbiorowa pod red. Adama Mazurkiewicza (wersja elektroniczna), Nanonauki i nanotechnologie, Instytut Technologii Eksploatacji ITEE - PIB / 2007.
5. Kurzydłowski K,. Lewandowska M.: Nanomateriały inżynierskie – konstrukcyjne i funkcjonalne, Wydawnictwo Naukowe PWN Warszawa 2010.
6. Wajda A., Wybieralska K., Przykłady praktycznego wykorzystania skomplikowanych struktur natury, Zeszyty naukowe 244, Uniwersytety Ekonomiczny w Poznaniu, Poznań 2012.
7. Rymuza Z.: Konstrukcja i eksploatacja mikrołożysk ślizgowych, Rozdział w monografii pod redakcją Ozimina D.: Tarcie, zużycie, smarowanie wybranych węzłów tribologicznych, Wydawnictwo Politechniki Świętokrzyskiej w Kielcach, Kielce 2013
8. Li H., Lv S., Fang Y., Bio-inspired micro/nanostructures for flexible and stretchable electronics. Nano Research, 13(5): 1244–1252, 2020.
9. Kan C.W., Lam Y.L., Future Trend in Wearable Electronics in the Textile Industry. Applied Science, 11, 1-17, 2021.