





COURSE SPECIFICATION

Course code	full-time programme:	M#2-S1-ME-207B						
	part-time programme:							
Course title in Polish	Podstawy nanotechnolog	Podstawy nanotechnologii						
Course title in English	Fundamentals of Nanotec	hnology						
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	full-time programme	Semester II
delivery	part-time programme	
Pre-requisites		
Examination required (YES/NO)		NO
ECTS value		2

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









LEARNING OUTCOMES

Category of outcome	Outcome code	Course learning outcomes	Corresponding programme outcome code
	W01	The student has knowledge of physics (including mechanics, thermodynamics and fluid mechanics) and chemistry.	MiBM1_W02
	W02	The student has knowledge in the field of mechatronics, electrical engineering, electronics, automation for formulating and solving simple technical problems	MiBM1_W04
Knowledge	W03	The student has knowledge in the field of micro/nanotechnology: modern engineering materials, their research methods and application areas	MiBM1_W08 MiBM1_W10
	W04	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
	The student has the I W05 organize work in accor	The student has the knowledge necessary to organize work in accordance with occupational health and safety regulations.	MiBM1_W19
	U01	Student is able to use Polish and foreign-language literature, obtain knowledge from other sources and interpret it correctly.	MiBM1_U03
	U02	Student is able to organize a workstation, operate instruments, devices and machines in accordance with applicable safety rules	MiBM1_U08 MiBM1_U11
Skills	U03	The student is able to select the appropriate material for the operational function, classify wear processes and ways of minimizing them.	MiBM1_U14
	U04	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
	K01	MiBM1_K01	
Competence	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
	К03	The student is aware of the need for personal development and understands the need to constantly supplement their knowledge of materials science in order to improve their professional qualifications.	MiBM1_K03











COURSE CONTENT

Type of instruction lecture	Topics covered
lecture	History of nanotechnology – breakthrough concepts, inventions, discoveries. Nanotechnology - classification of research and application areas. Examples of processes occurring in nature on the "nano" scale. Classification of nanomaterials: nanometals, nanopowders, ceramic nanosinters, nanofibers, nano-structured coatings and surface layers. Nanomaterials and functional composites with advanced physicochemical and functional properties - methods of preparation. Carbon nanostructures (graphene, nanotubes, fullerenes, nanofibers, nanobulbs, nanocorners) - properties, preparation and examples of applications in machine construction. Construction and principle of operation of devices used to produce surface nanolayers and coatings - deposition of atomic layers, ion implantation. Structure, principle of operation and imaging capabilities using scanning electron microscopy. Benefits and threats resulting from the use of nanotechnology in mechatronics and machine construction. Prospects for the development of nanotechnology (directions and limitations).
laboratory	Preparation of samples for technological processes. Selection of the type of nanolayers and nanocoatings and their deposition parameters depending on the operational function. Deposition of nanolayers using the atomic layer technique - ALD. Observations of morphology and analysis of chemical composition using scanning electron microscopy. Analysis of the geometric structure of the surface. Mechanical tests on the nanoscale: instrumental hardness, adhesion. Assessment of the impact of deposited coatings on tribological properties.

ASSESSMENT METHODS

Outcome		Methods of assessment (Mark with an X where applicable)									
code	Oral examination	Written examination	Test	Project	Report	Other					
W01			х								
W02			х								
W03			Х								
W04			Х								
W05			Х								
U01					х						
U02					х						
U03					х						
U04					х						
K01			Х								
K02			Х								
K03					х						







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

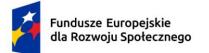
ECTS weighting												
			Student workload									Unit
No.	Activity type	full-time						•	rt-tir			
			C Pro	gram Lb	P	S	L C Lb P S					
1.			U			3	L	C	LD	Г	3	h
				15								
2.	Other contact hours (office hours, examination)	2	2 2								h	
3.	Total number of contact hours		34					h				
4.	Number 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				

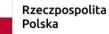
READING LIST

- 1. Sheeja D., Tay B.K., Leong K.W., Lee C.H.: Effect of film thickness on the stress and adhesion of diamond-like carbon coatings. Diamond and Related Materials 11, 1643-1647, 2002.
- 2. Small Wonders, Endless Frontiers: A Review of the National Nanotechnology Initiative, National Academies Press (US) 2002.
- 3. Bull S.J., Bhat D. G., Staia M.H.: Properties and performance of commercial TiCN coatings, Surface and Coatings Technology 163-164, 507-514, 2003.
- 4. Balzani V., Credi A., Venturi M.: Molecular devices and machines : concepts and perspectives for the nanoworld. Weinheim: Wiley-VCH, 2008.
- 5. Kubiński W.: Materiałoznawstwo. Tom 1. Podstawowe materiały stosowane w technice. Wyd. AGH, Kraków 2012.
- 6. Mądziel M., Nanotechnology as a future of road transport development. Autobusy, 17, 12, 2016.











- 7. Krzyńska A., Kaczorowski M.: Konstrukcyjne materiały metalowe, ceramiczne i kompozytowe. Oficyna Wydawnicza Politechniki Warszawskiej, Warszwa 2020.
- 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.



Projekt "Dostosowanie kształcenia w Politechnice Świętokrzyskiej do potrzeb współczesnej gospodarki" nr FERS.01.05-IP.08-0234/23