SYLLABUS

Course description

Course code	Course	**PODSTAWY NANOTECHNOLOGII**	
MB/O/I/NST/C2A.2		**FUNDAMENTALS OF NANOTECHNOLOGY**	
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	[h]	
	Laboratory	12 [h]	
Linkage of the course	with the education profile	Associated with the conducted scientific activity in the discipline to which the field of study is assigned	2 ECTS
	with qualifications	It serves the student's acquisition of engineering competencies	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	Basic knowledge and skills in the field of materials engineering.		
Department	Faculty of Mechanical Engineering		
Coordinator	dr inż. Wojciech Kucharczyk		
The website of the basic organizational unit	http://www.wm.uniwersytetradom.pl/		
E-mail address, phone number of the coordinator	wojciech.kucharczyk@uthrad.pl, tel. 48 361 7680		

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

Learning Objective:	The aim is to acquire the ability to properly use a new class of materials, which are nanomaterials, and the basics of shaping their properties.
Curriculum Content:	The content of the classes is related to the conducted scientific research. **Lecture.** The concept, division, structure, properties of nanomaterials. Obtaining nanomaterials (mechanical synthesis, high-energy grinding, fast liquid cooling method, HDDR method, vapor deposition, thin film technique, etc.). Forming and sintering of nanopowders. Nanocrystalline magnetic materials. Nanoparticles as nanofillers for composite materials. Metal, ceramic and polymer matrix nanocomposites. Methods of producing polymer nanocomposites. Theoretical and technical conditions of elaboration of nanometric surface layers. Nanotechnologies for the production of surface layers and coatings. Research methods of nanomaterials. Possibilities of using nanomaterials and nanocomposites. **Lab.** Production of nanometric oxide layers by electrochemical method. Determination of the actual surface of the construction material by the potentiometric method. Investigation of thin surface layers by electrochemical spectroscopy. Production of polymer nanocomposites by in situ intercalative polymerization. Dispersion and adsorption of nanoparticles in a polymer solution (solution intercalation). Study of the influence of mineral nanoparticles on the mechanical properties of polymer composites. Testing the surface condition and hardness of maraging nanosteel.
Didactic (educational) methods:	Conventional **lecture** with the use of audiovisual means, verbal problem method. **Lab.** Laboratory method (experiment) and experimental method.
Course assessment type, the criteria for assessing the achieved learning outcomes, and the method of calculating the final grade:	**Lecture.** Written test - the average of grades from partial questions. **Lab.** The arithmetic mean of the grades obtained by the student for each laboratory exercise (the grade from the exercise is the average of the grades from the preliminary test and the individually prepared report).

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	Has basic knowledge about the types, structure and characteristic properties of nanomaterials.	K_WG13	Lecture	Written test	Arithmetic mean of sub-question scores
W2	Has knowledge of commonly used methods of producing nanoparticles and materials using them.	K_WG14 K_WG16	Lecture	Written test	Arithmetic mean of sub-question scores
W3	Describes the processes of changing the properties of materials due to the addition of nanoparticles.	K_WG13	Lecture	Written test	Arithmetic mean of sub-question scores
U1	He is able to select components, select methods, and then produce polymer nanocomposites in laboratory conditions.	K_UW09 K_UW10 K_UW11	Laboratory classes	Passing individual practical exercises	Arithmetic average of grades from practical exercises
U2	He can work in a team.	K_UO20	Laboratory classes	Passing individual practical exercises	Arithmetic average of grades from practical exercises
K1	He is ready to analyze the tasks assigned for implementation in terms of defining priorities, serving the maximum efficiency of task	K_KK01	Laboratory classes	Passing individual practical	Arithmetic average of grades from practical exercises

	performance, and the comprehensive effects of its implementation.			exercises	

Literature and teaching aids
[1] Ever J. Barbero (Editor): Multifunctional Composites. ISBN: 978-1-51-680452-8, 2016. [1] Rucki M., Kucharczyk W., Żurowski W., Hevorkian E.: New Engineering Materials: A Handbook (w druku). Wyd. UTH Radom, Radom 2023. [2] Red. Kurzydłowski K., Lewandowska M.: Nanomateriały inżynierskie, konstrukcyjne i funkcjonalne. PWN. Warszawa 2015. [3] Red. Kelsall R.W., Hamley I.W., Geoghegan M.: Nanotechnologie. PWN. Warszawa 2008. [4] Kucharczyk W., Mazurkiewicz A., Żurowski W.: Nowoczesne materiały konstrukcyjne. Wybrane zagadnienia. Wydanie III. Wyd. Politechniki Radomskiej. Radom. 2011. [5] Wojtkun F. Sołncew J. P.: Materiały specjalnego przeznaczenia. Wyd. II. Wyd. Politechniki Radomskiej. Radom. 2001.

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 laboratory classes	X	X	12 [h]
Meeting with teachers during their duty hours	2 [h]	X	X
Preparation for lectures / laboratory classes Preparation for credit (written test)	X	10 [h] / 12 [h] 6 [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	50 [h] / 2 ECTS		

Additional information, comments
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. 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).