Kielce University of Technology

FACULTY OF MECHATRONICS AND MECHANICAL ENGINEERING

Annex 9
to the Rector's Ordinance No. 35/19
of 12 June 2019

COURSE SPECIFICATION

Course code	**M#1-S1-ME-211b**
Course title in Polish	**Podstawy nanotechnologii**
Course title in English	**Fundamentals of Nanotechnology**
Valid from (academic year)	**2019/2020**

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**first-cycle**
Type of education	**academic**
Mode of study	**full-time**
Specialism	**all**
Department responsible	**Department of Mechanics**
Course leader	**dr hab. inż. Monika Madej, prof. PŚk**
Approved by	

COURSE OVERVIEW

Course type	**basic**
Course status	**elective**
Language of instruction	English
Semester of delivery	**semester 2**
Pre-requisites	**None**
Examination required (YES/NO)	YES
ECTS value	**3**

Mode of instruction	**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	**15**		**15**		

LEARNING OUTCOMES

Category of outcome	Out-come code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	Has knowledge of physics, including mechanics, kinematics, optics, electricity and magnetism, in particular the knowledge necessary to understand the basic physical phenomena occurring in all types of machines and mechanical devices, including in systems enabling the shaping and processing of various types of materials.	MiBM1_W02
	W02	The student has the knowledge needed to organize work in accordance with health and safety regulations.	MiBM1_W04
	W03	Has basic knowledge of nanotechnology and nanotechnology, with particular emphasis on their application in mechanics and machine construction.	MiBM1_W13
	W04	Has a comprehensive knowledge of surface engineering, including various related issues, e.g. modeling of the surface layer, assessment of the condition and durability of the surface, tribological tests.	MiBM1_W22
Skills	U01	Can perform measurements of basic geometrical, mechanical, electrical and other quantities related to the manufacturing process of machine parts, can interpret the obtained results, analyze measurement uncertainty and draw conclusions.	MiBM1_U11
	U02	Can use analytical, numerical and simulation methods to formulate and solve engineering tasks in the field of mechanics and machine construction, can properly interpret and use the results of the experiment.	MiBM1_U12
	U03	The student is able to choose the appropriate engineering materials to ensure the correct operation of the machine.	MiBM1_U14
Competence	K01	Can perform measurements of basic geometrical, mechanical, electrical and other quantities related to the manufacturing process of machine parts, can interpret the obtained results, analyze measurement uncertainty and draw conclusions.	MiBM1K03
	K02	Can use analytical, numerical and simulation methods to formulate and solve engineering tasks in the field of mechanics and machine construction, can properly interpret and use the results of the experiment.	MiBM1_K05
	K03	The student is able to choose the appropriate engineering materials to ensure the correct operation of the machine.	MiBM1_K06

COURSE CONTENT

Type of instruction*	Topics covered
lecture	1. History of nanotechnology. Development of apparatus used in nanotechnology.
	2. Nanotechnologies – classification of research and application areas.
	3. Examples of nano-scale processes in nature.
	4. Nanotechnology in issues of: a) observation of structures, b) construction and operation of measuring equipment, c) properties of nanomaterials, d) fabrication (production) of nanostructures, e) structure and types of nanoscale devices.
	5. Benefits and threats resulting from the use of nanotechnology.
	6. Basic methods of producing nanomaterials.

	7. Methods of obtaining nanopowders and nanocomposites: granular, layered, fibrous, zero-dimensional, one-dimensional and three-dimensional.
	8. Properties of nanomaterials.
	9. Getting acquainted with the structure, principles of operation of devices and the processes of producing surface layers and coatings using the following techniques: a) ion implantation, b) physical vapor deposition – PVD, c) chemical vapor deposition – CVD, d) atomic layer deposition – ALD.
	10. Carbon nanostructures – properties, preparation and examples of applications in technique.
	11. Development of nanotechnology in Poland and in the world.
laboratory	1. Modeling of nanostructures.
	2. Selection of manufacturing techniques depending on the operational function.
	3. Selection of parameters for the production of surface layers and coatings using the PVD technique
	4. Physical vapor deposition – PVD.
	5. Selection of parameters for the production of surface layers and coatings using the CVD technique.
	6. Chemical vapor deposition – CVD.
	7. Selection of parameters for the production of surface layers and coatings using the PACVD technique.
	8. Chemical vapor deposition assisted by plasma – PACVD.
	9. Selection of parameters for the production of surface layers and coatings using the ALD technique.
	10. Atomic layers deposition – ALD.
	11. Observation of nanostructures with the use of measuring equipment.
	12. Examination of the properties of ceramic nanomaterials using the EDS and SEM methods.
	13. Measurements of properties: a) rheological, b) mechanical, c) tribological

*) Please delete rows in the table above that are not applicable.

ASSESSMENT METHODS

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

ASSESSMENT TYPE AND CRITERIA

Mode of instruction*	Assessment type	Assessment criteria
lecture	**examination assessment**	.
laboratory	non-examination assessment	*The pass mark is a minimum of 50% for all the in-class tests.*

*) Please delete rows in the table above that are not applicable.

OVERALL STUDENT WORKLOAD

ECTS weighting							
	Activity type	**Student workload**					**Unit**
1.	Scheduled contact hours	L	C	Lab	P	S	h
		15		15			
2.	Other contact hours (office hours, examination)	4		2			h
3.	**Total number of contact hours**	**36**					h
4.	**Number of ECTS credits for contact hours**	**1,4**					ECTS
5.	**Number of independent study hours**	**39**					h
6.	**Number of ECTS credits for independent study hours**	**1,6**					ECTS
7.	**Number of practical hours**	**38**					h
8.	**Number of ECTS credits for practical hours**	**1,5**					ECTS
9.	**Total study time**	**75**					h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**3**					ECTS

READING LIST

1. Handbook of Nanotechnology, ed,. Bushan, Springer Science + Biznes Media. Springer Berlin Heildelberg, New York 2007
2. Regis E., Nanotechnologia: narodziny nowej nauki, czyli Świat cząsteczka po cząsteczce, Prószyński i S-ka, 2001
3. Szuber J., Powierzchniowe metody badawcze w nanotechnologii półprzewodnikowej, Wydaw. Politechniki Śląskiej, 2002
4. Kelsall R, Hamley I, Geoghegan M, *Nanotechnologie,* PWN, Warszawa 2012
5. Nanoscale Science and Technology, eds. R.W. Kelsall, I.W.Hamley, M.Geoghegan.John Wiley & Sons Ltd, Chichester 2005.
6. Mieczysław Jurczyk, Nanomateriały: wybrane zagadnienia, Poznań: Wydaw. Politechniki Poznańskiej, 2001
7. Allhoff F., Lin P., Nanotechnology & Society: Current and Emerging Ethical Issues, SpringerScience & Business Media, 3 kwi 2008