

FACULTY Chemistry					
SUBJECT CARD					
Name of subject in Polish	Nanoinżynieria – postawy i zastosowania				
Name of subject in English	Nanoengineering – fundamentals and application.				
Main field of study (if applicable):	Chemical Engineering				
Specialization (if applicable):	ADVANCED CHEM.ENG. AND NANOTECHNOLOGY				
Profile:	academic				
Level and form of studies:	2 level, full-time				
Kind of subject:	obligatory				
Subject code	ICC024033				
Group of courses	NO				
	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	60		30	30	30
Number of hours of total student workload (CNPS)	180		60	60	60
Form of crediting	exam		crediting with grade	crediting with grade	crediting with grade
For group of courses mark (X) final course					
Number of ECTS points	6		2	2	2
including number of ECTS points for practical (P) classes			2	2	2
including number of ECTS points for direct teacher-student contact (BK) classes	2		1	1	1
*PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES					
1. Basics Physic, Physical Chemistry and Chemical Engineering					
2. Basic programming and numerical algorithms					
3. Chemical Thermodynamics					
SUBJECT OBJECTIVES					
C1 Educate a new generation of engineers who can participate in the creation of new high-technology companies					
C2 Prepare the students to construct and realize individually or in a team all steps of a research and development project in the domain of nano-sciences et nanotechnologies					
C3 Give the students expertise in numerical modeling to predict the chemical and physical properties at the nano-scale					
C4 Prepare the students for a career in the field of nanotechnology, by offering them a robust experience in this multidisciplinary domain of sciences and engineering					
SUBJECT LEARNING OUTCOMES					
relating to knowledge:					
PEK_W01 know basics of nano-engineering					
PEK_W02 knows the modern industrial nano-technological processes					
PEK_W03 knows the principles of modeling in the nanoscale					
PEK_W04 knows the applications of the materials used in the nano-technological processes					
relating to skills:					
PEK_U01 can propose the numerical models and carry out modeling of nano-systems					
PEK_U02 can calculate the physio-chemical properties of the nano-systems					
PEK_U03 can apply the transport phenomenon in the design of the processes					
relating to social competences:					
PEK_K01 can work in the group projects					
PEK_K02 can make a presentation of the results					

PROGRAMME CONTENT		
Lectures		Number of hours
Lec 1	Why properties of nano-materials are different?	2
Lec 2	The role of intermolecular interactions at nanoscale	2
Lec 3	Introduction into nanotechnology	2
Lec 4	Molecular nano-machines	2
Lec 5	Adsorption and nanoporous materials	2
Lec 6	Gas storage in nanopores	2
Lec 7	Modeling and simulations of nano-systems	4
Lec 8	Nano-applications in nature	2
Lec 9	Importance of surface et nanoscale: interface and surface tension, interface equilibria	4
Lec 10	Nanoporous materials: important materials in Nanoengineering	4
Lec 11	Thermodynamics in nanoscale: methodology, Kelvin equation, thermodynamics of adsorption	2
Lec 12	Adsorption in nanopores: capillary condensation, hysteresis, IUPAC classification	4
Lec 13	Theoretical models of adsorption: Langmuir, BET, numerical approach	2
Lec 14	Characterization of the nanoporous materials: specific surface, pore size distribution	4
Lec 15	Statistical thermodynamics of adsorption: exact models (Langmuir, BET)	2
Lec 16	Applications: gas storage	2
Lec 17	Applications: gas/liquid separations	3
Lec 18	Nanoemulsions - production, characteristics, application	2
Lec 19	Nanosilica - synthesis, characteristics, application	2
Lec 20	Silver nanoparticles in materials - synthesis, characteristics, application	2
Lec 21	Drug carriers on a nano and micro scale.	2
Lec 22	Gel carriers - production, application, release mechanism	2
Lec 23	Polymer carriers - production, application, release mechanism	2
Lec 24	Carriers in targeted therapy	2
Lec 25	Nanosensors in medicine	1
	Total hours	60
Laboratory		Number of hours
Lab 1	Nanoemulsions – preparation, characterization, and stability study	5
Lab 2	Silica nanoparticles – preparation and characterization	5
Lab 3	Bioinspired synthesis and characterization of silver nanoparticles	5
Lab 4	Core-shell carriers preparation	10
Lab 5	Kinetics of drug release.	5
	Total hours	30
Project		Number of hours

Proj 1	Modeling of porous materials	6
Proj 2	Modeling of adsorption in porous materials	6
Proj 3	Phase transformations in porous systems with adsorbed gases	6
Proj 4	Separation and storage gases in nanoporous systems	6
Proj 5	Modeling of diffusion in nanoporous systems	6
	Total hours	30
Seminar		Number of hours
Sem 1	Adsorption: state of art in storage and separation	3
Sem 2	Adsorption and nanoporous materials: possible applications	3
Sem 3	Gas storage in nanopores: perspective	3
Sem 4	Modeling and simulations of nano-systems: basic algorithms	3
Sem 5	Nano-applications in nature	3
Sem 6	Importance of surface at nanoscale: interface and surface tension, interface equilibria	3
Sem 7	Porous materials: numerical modeling	3
Sem 8	Molecular modeling of adsorption in nanopores	3
Sem 9	Adsorption in nanopores: diffusion, wetting	3
Sem 10	Numerical techniques of adsorption modeling: Monte Carlo and Molecular Dynamics	3
	Total hours	30
TEACHING TOOLS USED		
N1. Lectures with multimedia presentations N2. Internet search and discussion N3. Project – working in team N4. Consultations N5. Students presentations		
EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_U01 - U03	Project
F2	PEK_K01 - K02	Presentation
P: Final exam		
PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE:</u>		
[1] Introduction to nanoscience, S.M.Lindsay		
[2] Nanometer structures: Theory, modeling and simulation, A.Lakhtakia,		
[3] Applied biophysics for drug discovery, D.Huddler, E.Zartler		
[4] Biomedical Engineering, W.M.Salzman		
[5] Advanced Polymers in Medicine, F.Puoci		
<u>SECONDARY LITERATURE:</u>		
[1] Internet search		
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)		
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