

FACULTY OF CHEMISTRY					
SUBJECT CARD					
Name of subject in English:	Nanoscale physics				
Main field of study (if applicable):	Chemistry				
Specialization (if applicable):	Advanced nano and biomaterials				
Profile:	academic				
Level and form of studies:	2nd level, full-time				
Kind of subject:	obligatory				
Subject code:					
Group of courses:	NO				
	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)					
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark (X) final course	X		X		
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BU) classes	1		0,5		
PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES					
1. Fundamentals of optical spectroscopy. 2. Fundamentals of solid state physics.					
SUBJECT OBJECTIVES					
C1 To provide students with a general knowledge on physical phenomena occurring in inorganic nanostructures of various types.					
C2 To provide students with a general knowledge on modern manufacturing techniques of various nanomaterials.					
C3 To provide students with a general knowledge on modern applications of inorganic nanostructures.					
C4 To provide students with a general knowledge on experimental techniques used for inorganic nanostructures investigations.					
C5 To provide student with a ability to work in group at solving different experimental as well theoretical problems occurring during the laboratories.					
SUBJECT LEARNING OUTCOMES					
related to knowledge:					
PEK_W01 student knows the principles of different experimental techniques used for inorganic nanostructures analysis.					
PEK_W02 student knows modern theories/technologies/ related with semiconducting nanomaterials.					
PEK_W03 student knows and understands the principles of the experimental methods used in nanostructures investigations.					
related to skills:					
PEK_U01 student can apply the principles of different experimental techniques to analyze semiconducting					

nanomaterials.		
PEK_U02 student is able to analyze and critically evaluate experimental results obtained for spectroscopic data obtained for semiconducting nanomaterials.		
related to social competences:		
PEK_K01 student understands the need to inform the public about the need to achieve the goals of sustainable development in technologies for the production of new materials, energy and environmental protection.		
PEK_K02 student is able to work in a group, performing various roles including group leader.		
PEK_K03 student is aware of the social role of the engineer.		
PEK_K04 student is ready to critically evaluate his/her knowledge and received content.		
PROGRAMME CONTENT		
Lectures		Number of hours
Lec 1	Introduction to nanotechnology, nanostructures and discussion on the main civilization problems and market demands which stimulate nanotechnology development and defines new challenges for engineers.	4
Lec 2	Basic concepts of solid state physics. Excitons, Plasmons, Polaritons, Plexitons. Crystal vs. Quantum Box - electron energy diagrams, energy band-sets, density of states, optical properties.	4
Lec 3	Basic concepts of physics and chemistry of inorganic nanostructures. Size effects, shape effects, surface effects.	2
Lec 4	Optical properties of nanocrystals: electron confinement, dielectric confinement, phonon confinement, core-shell structures, nanocrystals in matrix.	2
Lec 5	Methods of nanostructures growth: Chemical Vapor Deposition and Physical Vapor Deposition methods.	2
Lec 6	Methods of nanostructures growth: wet chemistry methods.	2
Lec 7	Nanocrystals applications in biology and medicine.	2
Lec 8	Nanocrystals applications in optoelectronics.	2
Lec 9	Nanocrystals applications in photovoltaics.	2
Lec 10	Main experimental methods used for nanostructures investigations. Setups, hands-on and deep theoretical insight. Photoluminescence, Photoluminescence Decay, Photoluminescence Excitation, Absorbance, Raman Spectroscopy.	2
Lec 11	Advanced experimental methods used for nanostructures investigations. Single nanocrystals spectroscopy. Super-resolution imaging.	2
Laboratory		Number of hours
Lab 1	Introduction. Safety. Setups description.	3
Lab 2	Absorbance of semiconducting nanostructures.	3
Lab 3	Photoluminescence Decay of semiconducting nanostructures.	3
Lab 4	Photoluminescence Excitation of semiconducting nanostructures.	3
Lab 5	Photoluminescence of up-converting nanostructures.	3
TEACHING TOOLS USED		

N1. Multimedia presentation		
N2. Lectures		
N3. Hands-on experiments discussed during lectures.		
N4. Scientific reports.		
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		
F2		
F3		
P		
PRIMARY AND SECONDARY LITERATURE		
PRIMARY LITERATURE:		
[1] <i>Nanoscale Materials in Chemistry</i> , Second Edition, Edited by Kenneth J. Klabunde and Ryan M. Richards, 2009 by John Wiley & Sons, Inc.		
[2] <i>Nanocrystals-Synthesis, Properties and Applications - Series: Springer Series in Materials Science</i> , Vol. 95, Rao, C.N.R., Thomas, P. John, Kulkarni, G.U. 2007		
[3] <i>Semiconductor Nanocrystal Quantum Dots: Synthesis, Assembly, Spectroscopy and Applications</i> , Andrey L. Rogach, Springer 2008		
[4] <i>Colloids and Colloid Assemblies: Synthesis, Modification, Organization and Utilization of Colloid Particles</i> , Frank Caruso, John Wiley & Sons 2006		
[5] <i>Highlights in Colloid Science</i> , Dima Platikanov, Dotchi Exerowa, John Wiley & Sons 2009		
[6] <i>Colloid Science: Principles, Methods and Applications</i> , Terence Cosgrove, John Wiley & Sons 2010.		
[7] <i>Functional Coatings: By Polymer Microencapsulation</i> , Swapan Kumar Ghosh, John Wiley & Sons 2006.		
[8] <i>Nano-Surface Chemistry</i> , Morton Rosoff, Taylor & Francis, 2001.		
[9] <i>Colloid Chemistry II</i> , Markus Antonietti, Springer 2003.		
[10] <i>Applied Colloid and Surface Chemistry</i> , Richard Pashley, Marilyn Karaman, John Wiley & Sons 2005		
[11] <i>Surface Chemistry</i> , A. Goel, Discovery Publishing House 2006.		
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)		
Dr hab. inż. Artur Podhorodecki, University Professor, Artur.p.podhorodecki@pwr.edu.pl		