Zał. nr 5 do ZW 78/2023

Attachment no. 4. to the Program of Studies

FACULTY of Chemistry

SUBJECT CARD

Name of subject in Polish Fizyka w nanoskali
Name of subject in English Nanoscale physics

Main field of study (if applicable): Advanced Nano and Biomaterials - MONABIPHOT

Specialization (if applicable):
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code W03ANB-SM2010W, W03ANB-SM2010L
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)	50		50		
Form of crediting (Examination / crediting with grade)	crediting with grade		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	2		2		
including number of ECTS points for practical classes (P)			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,3		0,7		

*delete as not necessary

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 EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 student knows the principles of different experimental techniques used for inorganic nanostructures analysis.

PEU_W02 student knows modern theories/technologies/ related with semiconducting nanomaterials.

PEU_W03 student knows and understands the principles of the experimental methods used in nanostructures investigations.

relating to skills:

PEU_U01 student can apply the principles of different experimental techniques to analyze semiconducting nanomaterials.

PEU_U02 student is able to analyze and critically evaluate experimental results obtained for spectroscopic data obtained for semiconducting nanomaterials.

relating to social competences:

PEU_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.

PEU_K02 student is able to work in a group, performing various roles including group leader.

PEU_K03 student is aware of the social role of the engineer.

PEU_K04 student is ready to critically evaluate his/her knowledge and received content.

PROGRAMME CONTENT

Lecture		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.	2
Lec 2	Basic concepts of solid state physics and solid state spectroscopy	2
Lec 3-4	Basic concepts of physics of nanostructures: Excitons, Plasmons, Polaritons, Plextitons. Crystal vs. Quantum Box - electron energy diagrams, energy band-off sets, density of states, optical properties.	4
Lec 5	Basic concepts of physics and chemistry of inorganic nanostructures. Size effects, shape effects, surface effects.	2
Lec 6	Optical properties of nanocrystals: electron confinement, dielectric confinement, phonon confinement, core-shell structures, nanocrystals in matrix.	2

Lec 7	Methods of nanostructures growth: Chemical Vapor Deposition and Physical Vapor Deposition methods.	2
Lec 8-9	Methods of nanostructures growth: wet chemistry methods.	4
Lec 10-11	Nanocrystals applications in biology and medicine.	4
Lec 12-13	Nanocrystals applications in optoelectronics.	4
Lec 14	Main experimental methods used for nanostructures investigations. Setups, hands-on and deep theoretical insight. Photoluminescence, Photoluminescence Decay, Photoluminescence Excitation, Absorbance, Raman Spectroscopy.	2
Lec 15	Advanced experimental methods used for nanostructures investigations. Single nanocrystals spectroscopy. Super-resolution imaging.	2
….		
	Total hours	30

Classes		**Number of hours**
Cl 1		
Cl 2		
Cl 3		
Cl 4		
..		
	Total hours	

Laboratory		**Number of hours**
Lab 1	Introduction. Safety. Setups description.	2
Lab 2	Photoluminescence Decay of semiconducting nanostructures & Photoluminescence of up-converting nanostructures.	5
Lab 3	Photoluminescence Excitation of semiconducting nanostructures.	3
Lab 4	Absorbance of semiconducting nanostructures	5
	Total hours	15

Project		**Number of hours**
Proj 1		
Proj 2		
Proj 3		
Proj 4		
…		
	Total hours	

Seminar		Number of hours
Semin 1		
Semin 2		
Semin 3		
…		
	Total hours	

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 code	Way of evaluating learning outcomes achievement
P1 (lecture)	PEU W01-03	test
P2 (seminar)	PEU U01-02, PEU K01-04	student presentation

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] *Nanoscale Materials in Chemistry*, Second Edition, Edited by Kenneth J. Klabunde and Ryan M. Richards, 2009 by John Wiley & Sons, Inc.

[2] *Nanocrystals-Synthesis, Properties and Applications - Series: Springer Series in Materials Science*, Vol. 95, **Rao**, C.N.R., **Thomas**, P. John, **Kulkarni,** G.U. 2007

[3] *Semiconductor Nanocrystal Quantum Dots: Synthesis, Assembly, Spectroscopy and Applications*, Andrey L. Rogach, Springer 2008

[4] *Colloids and Colloid Assemblies: Synthesis, Modification, Organization and Utilization of Colloid Particles*, Frank Caruso, John Wiley & Sons 2006

[5] *Highlights in Colloid Science*, Dimo Platikanov, Dotchi Exerowa, John Wiley & Sons 2009

[6] *Colloid Science: Principles, Methods and Applications*, Terence Cosgrove, John Wiley & Sons 2010.

[7] *Functional Coatings: By Polymer Microencapsulation*, Swapan Kumar Ghosh, John Wiley & Sons 2006.

[8] *Nano-Surface Chemistry*, Morton Rosoff, Taylor & Francis, 2001.

[9] *Colloid Chemistry II*, Markus Antonietti, Springer 2003.

[10] *Applied Colloid and Surface Chemistry*, Richard Pashley, Marilyn Karaman, John Wiley & Sons 2005

[11] *Surface Chemistry*, A. Goel, Discovery Publishing House 2006.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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