FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Nanomateriały
Name of subject in English	Nanomaterials
Main field of study (if applicable):	Chemistry and materials engineering
Specialization (if applicable):	Advanced Nano and Bio-materials – MONABIPHOT
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	IMC024016
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)	90				30
Form of crediting	Examination				crediting with grade
For group of courses mark (X) final course					
Number of ECTS points	3				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes	1				0,5

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General chemistry
2. Basics of physics and mathematics
3. Basics of biology

SUBJECT OBJECTIVES

C1 Obtaining additional knowledge in the field of chemistry, characterization and application of functional nanomaterials.
C2 Knowledge about modern hybrid and teranostic nanomaterials
C3 Obtaining additional knowledge about the functionalization of nanomaterials
C4 Acquainting students with modern methods of obtaining nanomaterials.
C5 Knowledge about the toxicity of nanomaterials

SUBJECT LEARNING OUTCOMES

relating to knowledge:

The person who passes the course

PEK_W01 - Has a structured, theoretically founded general knowledge covering key issues in the field of nanoscale, nanotechnology and nanoengineering material
PEK_W02 - knows new methods of synthesis of nanomaterials. Has basic knowledge in the field concepts related to the synthesis and classification of nanomaterials.
PEK_W03- knows modern methods of characterization of nanomaterials. Knows and understands basic concepts related to construction and advanced operation measuring apparatus.

PEK_W04- Has a structured and basic knowledge of spectroscopic techniques and laser. He understands and can explain the phenomena and processes occurring during the interaction of light with nanomaterials.
PEK_W05- Has knowledge about rare earth ions. He understands the concept
Jabłoński diagram. He knows the physical and chemical properties of materials doped with lanthanide ions.
PEK_W06- He knows and understands the concept of optical size effect in semiconductor material in nano scale. He knows the properties of semiconductor materials. He knows the basic methods of semiconductor materials synthesis. He understands the concept of electronic band structure in semiconductors in general.
PEK_W07- Has knowledge and understanding of the properties of metallic nanomaterials. He knows and understands the concept of surface plasmonic effect.
PEK_W08- He knows the crystalline forms of carbon nanoparticles. Has knowledge of the properties of carbon nanomaterials
PEK_W9- He knows the basic methods of nanomaterials functionalization.
PEK_W10- Understands and can explain the descriptions of regularities, phenomena and chemical and physical properties of hybrid and teranostic nanoparticles.
PEK_W11- Knows and understands selected applications of nanomaterials.
PEK_W12- He knows the most important scientific journals in the field of synthesis, properties and applications of nanomaterials. He knows the scientific databases and is able to search issues related to the technology of nanomaterials
PEK_W13- He knows and understands the perspectives and risks associated with synthesis and application of nanomaterials.

relating to skills:
The person who passes the course

PEK_U01 - Can name and define new nanomaterials and nanometric scale. Know basic concepts related to nanotechnology.

PEK_U02 - Can classify nanomaterials due to the type of synthesis, construction, physico-chemical properties and applications.

PEK_U03 - Can solve the synthesis protocol of nanomaterials. He can name and define the equipment necessary for the synthesis of nanomaterials. He can solve simple tasks in the synthesis of nanomaterials.
PEK_U04- He can name and define advanced characterization nanomaterials equipment. He knows what technique to use in order to obtain the desired one information on the properties of nanomaterials.
PEK_U05- He can name and classify lasers for testing nanomaterials. Know basic spectroscopic techniques in the study of nanomaterials. Can draw and discuss the Jabłoński diagram.
PEK_U06- He can name and define nanomaterials doped with rare earth ions. He knows the basic concepts associated with properties of nanomaterials doped with lanthanide ions.
PEK_U07- He can name and define semiconductor nanomaterials. Know basic concepts related to the properties of semiconductor structures.
PEK_U08- Can name and define plasmonic nanomaterials. He knows the basic concepts related to the properties of metallic nanomaterials.

PEK_U09- He can name and define carbon nanomaterials. He knows the basic concepts related to the properties of carbon nanomaterials.
PEK_U10- Has basic skills in the field of nanomaterials functionalization. Can solve the synthesis protocol for the functionalization of nanomaterials.
PEK_U11- Is able to name and define hybrid, teranostic and functional materials.
PEK_U12- He has skills in the use of nanomaterials in aplications.
PEK_U13- He knows the most important academic journal about nanomaterials. He can give examples scientific journals related to the subject of nanomaterials. He can search information in scientific databases from the scope of nanotechnology. He knows advanced concepts and terminology related to nanotechnology.
PEK_U14- Is able to make a critical analysis of the prospects of using nanomaterials and assess existing threats in the field of nanotechnology

PROGRAMME CONTENT

Lectures		**Number of hours**
Lec 1	Introductions to nanomaterials.	2
Lec 2	Classifications of nanomaterials	2
Lec 3	Modern techniques of synthesis of nanomaterials.	2
Lec 4	Advances method for nanomaterials characterization.	2
Lec 5	Photonics of nanomaterials	2
Lec 6	Nanoparticles doped lanthanide ions	2
Lec 7	Semiconductor nanoparticles	2
Lec 8	Metallic nanoparticles	2
Lec 9	Carbon nanomaterials	2
Lec 10	Methods of nanomaterials functionalization.	2
Lec 11	Hybrid and theranostic nanomaterials	2
Lec 12	Selected aplications of nanomaterials	2
Lec 13	An overview of the latest and most important scientific databases, patents and scientific articles in the field of advanced nanomaterial technology.	2
Lec 14	Prospects and risks associated with the use functional nanomaterials.	2
Lec 15	Test/exam	2
	Total hours	30
Seminar		**Number of hours**
Sem 1	Students presentations on topic Lec1	1
Sem 2	Students presentations on topic Lec2	1
Sem 3	Students presentations on topic Lec3	1
Sem 4	Students presentations on topic Lec4	1
Sem 5	Students presentations on topic Lec5	1
Sem 6	Students presentations on topic Lec6	1
Sem 7	Students presentations on topic Lec7	1
Sem 8	Students presentations on topic Lec8	1

Sem 9	Students presentations on topic Lec9	1
Sem 10	Students presentations on topic Lec10	1
Sem 11	Students presentations on topic Lec11	1
Sem 12	Students presentations on topic Lec12	1
Sem 13	Students presentations on topic Lec13	1
Sem 14	Students presentations on topic Lec14	1
Sem 15	Summary	1
	Total hours	15

TEACHING TOOLS USED

N1. Lecture using audiovisual tools
N2. Scientific discussion with the lecture participants

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 Lectures	PEK-W1 do W14	written test at the end of the semester
F2 Seminars		presentation of own an audiovisual lecture

C (test + presentation)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] R.W. Kelsall, I.W. Hamley, M. Geoghegan (red.) „Nanotechnologie", Warszawa, 2008, PWN
[2] K. Kurzydłowski, M. Lewandowska, „Nanomateriały inżynierskie konstrukcyjne i funkcjonalne" , Wydawnictwo Naukowe PWN, 2011
[3] L. Cademartiri, G. A. Ozin, „Nanochemia", Wydawnictwo Naukowe PWN, 2012
[4] Marciniak J. „Biomateriały", Gliwice 2002

SECONDARY LITERATURE:

[1] Paras N. Prasad, Nanophotonics, Wiley-Interscience, 2004
[2] Paras N. Prasad, Introduction to Nanomedicine and Nanobioengineering, Wiley, 2012
[3] Yoon Yeo, Nanoparticulate drug delivery systems : strategies, technologies, and applications, Wiley, 2013

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

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