FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in English: Advanced Functional Materials
Main field of study (if applicable): Chemistry and Materials Engineering
Specialization (if applicable): Advanced Nano- and Bio-biomaterials - Monabiphot
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: IMC024019
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		90		30
Number of hours of total student workload (CNPS)	90		180		60
Form of crediting	Exam		crediting with grade		crediting with grade
For group of courses mark (X) final course					
Number of ECTS points	3		6		2
including number of ECTS points for practical (P) classes			6		2
including number of ECTS points for direct teacher-student contact (BK) classes	1		3		1

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge of mathematics, physics and chemistry

\SUBJECT OBJECTIVES

C1 Extending knowledge about materials used in modern materials engineering.
C2 Acquisition of experience in independent development and presentation of the state of knowledge on the basis of scientific publications
C3 Getting to know measurement methods of advanced materials

SUBJECT EDUCATIONAL EFFECTS

related to knowledge:

PEK_W01 has general knowledge in the field of research carried out in modern material engineering
PEK_W02 has knowledge about the synthesis, properties and research of photorefractive materials
PEK_W03 has knowledge about the synthesis, properties and research of photochromic materials
PEK_W04 has knowledge about the synthesis, properties and research of thermo-, electro- and solvatochromes
PEK_W05 has knowledge about the production, properties and testing of organic and inorganic semiconductors
PEK_W06 has knowledge about the synthesis, properties and research of compounds based on coal
PEK_W07 has knowledge about the synthesis, properties and research of energy storage materials
PEK_W08 has knowledge about the production and testing of optical fibers and photonic crystals
PEK_W09 has knowledge about modern materials used in medicine
PEK_W10 has knowledge about the synthesis, properties and research of metamaterials
PEK_W11 has knowledge about the synthesis, properties and research of magnetic and ferroelectric materials
PEK_W12 has knowledge about the properties and research of superconductors
PEK_W13 has knowledge about the synthesis, properties and testing of porous materials
PEK_W14 has knowledge about the synthesis, properties and research of ceramic materials

PEK_W15 has knowledge about the synthesis, properties and studies of luminescent dyes

related to skills:

PEK_U01 student is able to independently develop and present the state of knowledge on the basis of scientific publications

PEK_U02 student is able to independently perform material tests with advanced techniques

PEK_U03 student is able to analyze and interpret the obtained results

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 chemicals, fuels, 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	Modern materials science	2
Lec 2	Photorefractive materials	2
Lec 3	Photochromic materials	2
Lec 4	Thermoplastic materials, electronic and solvatochromic	2
Lec 5	Organic and inorganic semiconductors	2
Lec 6	Carbon materials	2
Lec 7	Materials for energy storage	2
Lec 8	Fiber optics and photonic crystals	2
Lec 9	Materials in medicine	2
Lec 10	Metamaterials	2
Lec 11	Magnetic and ferroelectric materials	2
Lec 12	Superconductors	2
Lec 13	Porous materials	2
Lec 14	Ceramic materials	2
Lec 15	Luminescent dyes	2
Laboratory		**Number of hours**
Lab 1	BHP training. The way the laboratory is run. Locations and their discussion. Requirements for course credits.	6
Lab 2	The luminescent properties of organic dyes	6
Lab 3	Methods for determining the thickness of nanolayers	6
Lab 4	Nanomaterials - size effects	6
Lab 5	OFET - fabrication and characteristics	6
Lab 6	OLED - fabrication and characteristics	6
Lab 7	Characteristics of liquid crystals	6
Lab 8	Measurement of phototropic properties of liquid crystals	6
Lab 9	Two-dimensional thermo-optic analysis	6
Lab 10	Quantum efficiency, comparative method	6
Lab 11	Photochemical synthesis of nanostructured silver suspensions	6
Lab 12	Chemical synthesis of nanostructured gold suspensions	6

Lab 13	fabrication of nanolayers	6
Lab 14	Repetition of the material	6
Lab 15	Repetition of the material, checking knowledge and passing the course	6
Seminar		**Number of hours**
Sem 1	Student presentations on topic Lec 1	2
Sem 2	Student presentations on topic Lec 2	2
Sem 3	Student presentations on topic Lec 3	2
Sem 4	Student presentations on topic Lec 4	2
Sem 5	Student presentations on topic Lec 5	2
Sem 6	Student presentations on topic Lec 6	2
Sem 7	Student presentations on topic Lec 7	2
Sem 8	Student presentations on topic Lec 8	2
Sem 9	Student presentations on topic Lec 9	2
Sem 10	Student presentations on topic Lec 10	2
Sem 11	Student presentations on topic Lec 11	2
Sem 12	Student presentations on topic Lec 12	2
Sem 13	Student presentations on topic Lec 13	2
Sem 14	Student presentations on topic Lec 14	2
Sem 15	Student presentations on topic Lec 15	2

TEACHING TOOLS USED

N 1. Lecture with multimedia presentation and lecture using the board
N 2. Performing tasks in the laboratory
N 3. Problem discussion
N4. The tests check (short essays) - used on laboratory
N5. Reports from exercises laboratory

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1(laboratory)	PEK_U02	quizzes
F2(laboratory)	PEK_U03	reports
P (lecture)	PEK_W01 - PEK_W15	final exam
P (laboratory) = (F1 + F2) / 2		
P (seminar)	PEK_U01	evaluation of multimedia presentation

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Małgorzata Lewandowska, Krzysztof Kurzydłowski, Structural Engineering Nanomaterials, PWN 2011
[2] Original articles from Web of Science
[3] Internet source

SUPPLEMENTARY LITERATURE:

[1] Internal instructions for individual laboratory classes

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

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