FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in English: Biomaterials
Main field of study (if applicable): Chemistry and Engineering of Materials
Specialization (if applicable): Advanced nano and biomaterials
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: optional
Subject code: IMC020022
Group of courses: NO

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of physics.
2. Fundamentals of chemistry
3. Fundamentals of biology on the high school level

SUBJECT OBJECTIVES

C1 To provide students with additional knowledge in the field of synthesis, characterization and application of functional biomaterials.

C2 Familiarize students with knowledge about modern biomaterials
C3 To provide students with an additional knowledge about biological materials
C4 Familiarizing students with modern biomaterials
C5 To provide student knowledge about the toxicity of nanomaterials

SUBJECT EDUCATIONAL EFFECTS

related to knowledge:

PEK_W01 student has a structured, theoretically founded general knowledge covering key issues in the field of bioengineering
PEK_W02 student knows new methods of biomaterials synthesis
PEK_W03 student knows modern methods of biomaterial characterization
PEK_W04 student knows the basic methods of biomaterial functionalization.
PEK_W06 student knows and understands selected applications of biomaterials.
PEK_W07 student knows and understands the perspectives and risks associated with the synthesis and use of nanomaterials.
PEK_W08 student knows the modern methods of delivering drugs in the body
PEK_W09 student has knowledge of the toxicity of nanobiomaterials
PEK_W10 student knows the applications of DNA as a matrix for nanomaterials
PEK_W11 student knows new methods of biosynthesis of nanomaterials

PEK_W12 student knows popular biopolymers and their application
PEK_W13 student has knowledge about photonic biocrystals
PEK_W14 student knows new biocompatible materials and prostheses. Has knowledge about the production of nanomaterials by 3-D technique

related to skills:

PEK_U01 – student can name and define biomaterials. He knows the latest literature on biomaterials. Searching for information on biomaterials from available sources.
PEK_U02 – student knows how to attach DNA to plasmonic and other plasmonic nanoparticles
PEK_U03- student is able to name and define advanced equipment for the characterization of biomaterials
PEK_U04- student has language skills in the field of biomaterial functionalization.
PEK_U05- student can name and define hybrid and functional materials.
PEK_U06- student has language skills in the field of biomaterials.
PEK_U07- student is able to make a critical analysis of the prospects for the use of biomaterials
PEK_U08- student can name and define new biomaterials
PEK_U09- student knows the latest literature on biomaterials
PEK_U10 - student knows the various applications of DNA
PEK_U11 – student can give an example of biosensor
PEK_U12 - student knows bio-derivatives for photonics and material engineering
PEK_U13- student can define photonic biocrystals
PEK_U14 - student knows the 3-D printing technique for biomaterials

related to social competences:

PEK_K01student 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 chemistry, physics and biomaterials. Definition and classification of biomaterials.Contemporary methods of biomaterials production. Biosynthesis, functionalization, coating with the use of DNA.	2
Lec 2	Cytotoxicity of nanomaterials. Presentation of basic methods of toxicity measurement in living organisms: tests on bacteria and animals, tests of activity and survival.	2
Lec 3	Liquid crystal DNA in the living body and its use as a matrix for new photonic materials.	2
Lec 4	Biosynthesis, biofunctionalization and biosensors. Synthesis of nanoparticles with the use of living organisms: plants, fungi, bacteria.	2
Lec 5	Synthesis of biological nanoparticles from proteins. Biofunctionalization of nanoparticles for applications as biological sensors.	2
Lec 6	Biopolymer materials: chitosan, silk, spider threads. The use of biofuous materials for photonics and materials engineering, unusual properties (durability, etc.).	2

Lec 7	Biological crystals. Introduction of the concept of photonic crystals, depicting naturally occurring photonic crystals (butterfly wings, beetles' shells). Possible use of natural biocrystals in photonics	2
Lec 8	Biocompatible materials: dentures. Nanoprinting of biomaterials in 3-D.	2
Lec 9	Contemporary and advanced methods of research and characterization of biomaterials. The use of laser and microscopic techniques, electrophoresis.	2
Lec 10	Cytotoxicity of nanomaterials. Presentation of basic methods of toxicity measurement in living organisms: tests on bacteria and animals, tests of activity and survival.	2
Lec 11	Printing of bone prostheses, scaffolds for cell and skin multiplication.	2
Lec 12	Methods of biomaterial functionalization and biofunctionalization. Attachment of DNA, mixed structures.	2
Lec 13	Plasmonic nanoparticles, use in cancer therapy and bioimaging. Selected applications of biomaterials in material engineering and medicine. Bioimaging, theranostics.	2
Lec 14	Modern methods of drug distribution. Porous nanoparticles, pharmacokinetics DNA as a matrix of biomaterials. Synthesis of nanoparticles using DNA.	2
Lec 15	Student presentations for passing the subject Presentation of students to pass the course, a summary of lectures	2

TEACHING TOOLS USED

N1. Multimedia presentation
N2. Lectures
N3. Hands-on experiments discussed during lectures.
N4. Scientific reports.

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 seminars		
F2		
F3		
P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Paras N. Prasad, Nanophotonics, Wiley-Interscience, 2004
[2] Challa Kumar, Nanomaterials for Medical Diagnosis and Therapy, Wiley, 2007
Yoon Yeo, Nanoparticulate drug delivery systems : strategies, technologies, and applications, Wiley, 2013

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

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