COURSE DESCRIPTION CARD - SYLLABUS

Course name
Nanotechnology and Biomaterials

Course

Field of study
Pharmaceutical Engineering
Year/Semester
2/4
Area of study (specialization)
-
Profile of study
general academic
Level of study
First-cycle studies
Course offered in
polish
Form of study
full-time
Requirements
compulsory

Number of hours

Lecture
15
Laboratory classes
15
Other (e.g. online)
0
Tutorials
0
Projects/seminars
0

Number of credit points
2

Lecturers

Responsible for the course/lecturer:
prof. Tomasz Gośliński, PhD, DSc

Responsible for the course/lecturer:

Prerequisites

Basic knowledge in the field of general and inorganic chemistry, physical chemistry, physics, organic chemistry and biochemistry.

Course objective

During the course student:

1. Studies the basics of nanotechnology and nanotechnology concepts.

2. Learns the basics of designing and producing biomaterials based on nanostructures for pharmaceutical purposes.

3. Learns the basic methods of obtaining nanomaterials and biomaterials as well as testing their physicochemical and biological properties.

4. Analyzes the benefits and possible threats resulting from the application of nanotechnology and biomaterials from a health and environmental point of view.

The aim of the lectures is to familiarize students with the basics of nanotechnology and the basics of designing of the new materials for pharmaceutical and biotechnological purposes, as well as trends regarding the use of nanostructures in pharmaceutical engineering.

The aim of the exercises is to familiarize students with the methods of production and physico-chemical assessment of nanomaterials used in modern medicine and pharmacy.

Course-related learning outcomes

Knowledge

Student:

K_W3. gains knowledge of physics to the extent that allows understanding and description of phenomena and physical processes related to nanotechnology.

K_W4. gains ordered, theoretically founded general knowledge in the field of inorganic, organic, physical and analytical chemistry enabling understanding, description and research of chemical phenomena and processes related to nanotechnology.

K_W7. gains knowledge of basic techniques, methods for characterizing and identifying nanoparticles and research tools used in nanotechnology. He knows the physicochemical properties of nanomaterials for pharmaceutical use affecting the biological activity of drugs, knows the classification of analytical techniques along with the criteria for choosing a method and method validation.

K_W9. gains knowledge of the basic conceptual categories and terminology used in nanotechnology.

K_W14. gains knowledge of the development of nanotechnology and the research methods used in it, as well as the impact of nanotechnology on the development of various industries in the country and in the world.

K_W26. gains knowledge of the risks associated with the production of nanoparticles and the principles of estimating the associated risk.

Skills

Student:

K_U2. Based on general knowledge, explains the basic phenomena associated with nanotechnology, distinguishes between types of nanoparticle production, can characterize various forms of nanomaterials, using theories used to describe them, methods and experimental techniques.

K_U8. Uses basic techniques, equipment and research equipment useful in nanotechnology and biomaterial synthesis.

K_U9. Is able to use the basic equipment and apparatus used in nanotechnology. Obtains nanomaterials with potential applications in medicine and pharmacy using various methods.

K_U11. Selects and applies analytical methods and techniques in qualitative and quantitative analysis of nanoparticles and biomaterials.

K_U12. Is able to plan and carry out simple experiments in the field of nanotechnology, both experimental and simulation, as well as interpret their results and draw conclusions.

K_U15. Is able to identify basic processes and unit operations in nanotechnology and formulate their specifications.

K_U22. Follows the OHS rules related to the work performed and is able to assess the hazards arising from unit operations in nanotechnology.

Social competences

Student:

K_K1. Is ready to critically assess knowledge, understands the need for further education, supplementing specialized knowledge and raising his professional, personal and social competences, understands the importance of knowledge in solving problems and is ready to consult experts.

K_K2. Is ready to make independent decisions and lead a team, critically evaluate own activities and team activities, accept responsibility for the effects of these activities, and is able to interact and work in a group, inspire and integrate professional environments.

K_K3. Is aware of the importance of understanding the non-technical aspects and effects of nanotechnology, including its impact on the environment and the associated responsibility for decisions.

K_K5. Is able to properly set priorities for the implementation of the task specified by himself or others, has a habit of supporting assistance and remedial actions, is responsible for the safety of own and other work, knows how to deal with emergencies.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Completion of the course will be based on (i) obtaining credit for properly prepared demonstrating reports and (ii) final written colloquium (min. 60% of correct answers), containing test and open questions, covering theoretical material belonging to a given demonstrating and lecture material.

Programme content

Lectures

1. Definitions of nanotechnology and its basic concepts, what nanotechnology does. History of nanotechnology development, nanoscale phenomena and processes, nanomaterials. Directions of development, concepts and possibilities of nanotechnology application in science, technology, medicine and environmental protection. Social consequences of the development and applications of nanotechnology and its development in Poland.

2. Nanotechnology in the process of discovering and researching a pharmaceutically active substance and developing a form of a drug. Nanotherapeutics. Bionanotechnology. Molecular medical diagnostics.

3. Techniques of physicochemical analysis of nanostructures. Methods for producing mechanical components and conventional nanotechnology technologies.

4. Biomaterials for medical purposes, including metallic, ceramic, polymer and carbon biomaterials. The use of 3D printers for the production of biomaterials with potential use in medicine and pharmacy.

Demonstrating

As part of the demonstrating, students will synthesize and study the absorption, emission and electrochemical properties of nanocrystallites (quantum dots). Students will become acquainted with the preparation and physico-chemical properties of selected nanoparticles (nanogold, dendrimers, liposomes, nanotubes, fullerenes, titanium oxide). They will assess the size of the obtained nanostructures using the dynamic light scattering method. They will assess the toxicity of selected nanostructures. They will learn about the methods of producing biomaterials, including using 3D stereolithographic techniques.

Teaching methods

Lectures will be conducted using audiovisual techniques. Laboratory demonstrating will be carried out according to procedures and will end with the preparation of protocols.

Bibliography

Basic

1. Jurczyk M., Nanomateriały. Wybrane zagadnienia, Wydawnictwo Politechniki Poznańskiej, Poznań 2001

2. Nanotechnologie, pod red. R.W. Kelsall, I.W. Hamley, M. Geoghegan, Wydawnictwo Naukowe PWN 2009

3. Jurczyk M., Jakubowicz J., Bionanomateriały, Wydawnictwo Politechniki Poznańskiej, Poznań 2008

Additional

1. Geoffrey O. A., Cademartiri L. (2016) Nanochemia. Podstawowe koncepcje, Wydawnictwo Naukowe PWN, Warszawa

2. Huczko A., Bystrzejewski M. (2007) Fulereny 20 lat później, Wydawnictwa UniwersytetuWarszawskiego, Warszawa

3. de Villiers M.M., Aramwit P., Kwon G.S. (2009) Nanotechnology in Drug Delivery, Springer AAPS

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	30	1,2
Student's own work (literature studies, preparation for laboratory classes, preparation for final test) [1]	20	0,8

[1] delete or add other activities as appropriate