COURSE DESCRIPTION CARD - SYLLABUS

Course name
Engineering of nanomaterials and functional materials [S1Bioinf1>INMF]

Course

Field of study
Bioinformatics

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of general and inorganic chemistry, physical chemistry, physics, organic chemistry and biochemistry. Knowledge of the basic equipment and reagents used in the chemical laboratory and the ability to perform chemical calculations. Student should also be able to use basic laboratory techniques. In addition, students should understand the need for training and improving their professional and personal competences.

Course objective

The aim of the lectures is to familiarize students with the basics of nanomaterial engineering and the basics of designing new functional materials for pharmaceutical and biotechnological purposes, as well as the directions of development, concepts and application possibilities of modern functional materials in science, technology and medicine. The aim of the exercises is to familiarize students with the methods of producing and physico-chemical assessment of intelligent materials used in modern biology, medicine and pharmacy. Providing practical knowledge of measurement techniques used in the assessment of the functional properties of nanomaterials that are of greatest importance in the biotechnology, chemical and pharmaceutical industries.

Course-related learning outcomes

Knowledge:
K_W03 Student has knowledge of physics useful for understanding and describing physical phenomena related to the engineering of functional materials.
K_W04 Student has knowledge of chemistry useful for formulating and solving simple tasks in the field of functional materials engineering, including the basic concepts and laws of chemistry, organic chemistry and biochemistry.
K_W08 Student has knowledge of selected groups of bioactive compounds, functional materials and their biochemical properties as well as their influence on cells and living organisms.
K_W15 Student has knowledge of the basics of designing nanotechnological processes and methods of their implementation, taking into account the equipment and processes used.
K_W16 Student has knowledge of modern methods of analysis that allow to evaluate the properties and structure of intelligent materials and nanomaterials for applications in biology and medicine.
K_W19 Student has knowledge of techniques and methods of synthesis of biomolecules and biologically active compounds and functional materials.
K_W20 Student has knowledge of development trends in intelligent materials engineering.

Skills:
K_U02 Student based on general knowledge, explains the basic phenomena related to the engineering of functional materials, distinguishes the types of particles produced, can characterize various forms of nanomaterials, using theories used to describe them, methods and experimental techniques.
K_U03 Student applies basic techniques, equipment and laboratory apparatus in the synthesis, isolation and purification of chemical compounds, including biomaterials and biologically active compounds used in the engineering of nanomaterials and the synthesis of functional materials and biomaterials.

Social competences:
K_K01 Student understands the need for lifelong learning and improving their competences.
K_K03 Student is able to properly define priorities for the implementation of a task set by himself or others, has the habit of supporting help and remedial actions, is responsible for the safety of his own work and that of others, knows how to act in emergency situations.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture:
The knowledge acquired during the lectures is verified in the form of a written exam at the end of the lectures. Passing threshold: 50% of points. Exam issues will be presented during lectures.
Laboratory:
As part of the laboratory classes, student"s skills are verified on the basis of a test on theoretical issues, which consists of 3-5 questions. For each of the exercises, the student receives a list of theoretical issues. Passing threshold: 50% of points. Additionally, reports containing a description of the course of the experiment and the calculations made are subject to evaluation.

Programme content

Materials and their influence on the development of culture, definition and place of functional materials. Directions of development, concepts and possibilities of using modern materials in science, technology and medicine. Methods of obtaining, classification and characterization of functional materials and biomaterials. Metal particles, ceramics, coatings, composite fibers, composites, carbon materials, powder materials, preparation and their applications. Methods of obtaining intelligent materials. Engineering of nanomaterials as an activity consisting in the design, construction, modification and maintenance of cost-effective solutions to practical problems, using scientific and technical knowledge. Biocompatibility of materials and main criteria for the production of biocompatible materials. Discussion of modern intelligent materials for applications in medicine, dentistry and veterinary medicine. Macromolecules for applications in medicine and pharmacy (configuration polymers, hyperbranched macromolecules, molecular brushes). Material engineering - selection of systems used in implantology, their applications and behavior under the influence of the environment of natural tissues. Degradation of functional materials based on the analysis of the degree of exposure to the physiological and biological environment. Procedures in drug technology, with particular emphasis on methods of improving the quality and effectiveness of drugs and their purity. Development of

modern processes of biotechnological products and specialized chemical products for applications in tissue engineering. Vectors for drug delivery - definition, types and classifications. Gene therapies - progress and challenges. Technologies for the production of bioactive materials for medical and multifunctional applications for the needs of various branches of the economy and the pharmaceutical industry. Techniques and materials for the functionalisation of sensor elements.

Course topics

none

Teaching methods

Practical laboratory classes, multimedia presentations.

Bibliography

Basic
1. Z. Floriańczyk, S. Penczek, Chemia Polimerów, t.III, Polimery naturalne i polimery o specjalnych właściwościach, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001
2. J. Marciniak, Biomateriały, Wyd. Politechniki Śląskiej, Gliwice, 2002
3. W. Kelsall, I.W. Hamley, M. Geoghegan; "Nanotechnologie", pod red. R., Wydawnictwo Naukowe PWN, 2009
4. Sokół J.L. Nanotechnologia w życiu człowieka. Economy and Managment 2012;1:18-29.
Additional
1. A. Zejc, M. Gorczyca (red.), „Chemia leków”, Wydawnictwo Lekarskie PZWL, Warszawa 2004.
2. Geoffrey O. A., Cademartiri L. (2016) Nanochemia. Podstawowe koncepcje, Wydawnictwo Naukowe PWN, Warszawa
3. Songjun Li, Jagdish Singh, He Li, and Ipsita A. Banerjee; "Biosensor Nanomaterials" Wiley ‑ VCH, 2011
4. 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	2,00
Classes requiring direct contact with the teacher	30	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	0,50