



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Natural and artificial enzymes and biomimetic reactions in modern chemical synthesis
[S1IFar2>NiSEoRBwNSC]

Course

Field of study

Pharmaceutical Engineering

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

0

Laboratory classes

0

Other

0

Tutorials

15

Projects/seminars

0

Number of credit points

1,00

Coordinators

dr hab. inż. Jakub Zdarta prof. PP

jakub.zdarta@put.poznan.pl

dr hab. inż. Marcin Wysokowski

marcin.wysokowski@put.poznan.pl

Lecturers

Prerequisites

The student starting this course should have basic knowledge of general inorganic, organic and physical chemistry in the scope enabling understanding of chemical phenomena and processes (core curriculum of the first and second year of full-time first-cycle studies). The student should also be able to obtain information from recommended literature sources, both in Polish and in English.

Course objective

Main aim is to familiarize students with examples of material and construction solutions developed by living organisms with an overview of their structure, properties and the function they serve in the body. To familiarize students with the hierarchical structure of biomaterials - the connection of chemistry, structure and mechanical properties of biomaterials and biominerals. Presentation of the role of biopolymers as building materials of selected biological structures. Understanding the essence of biomimetics in the context of design and synthesis of next-generation bio-inspired materials. Understanding the role of biomimetics in the design of biomedical materials. To familiarize students with the use of enzymes in chemical reactions and the methods of obtaining artificial enzymes imitating the action of enzymes found in nature, application of nanoparticles as enzyme biomimetics.

Course-related learning outcomes

Knowledge:

1. Student has knowledge of biological structures, can identify key phenomena observed in natural materials and assess their performance and utility in modern technological aspects or use them to design new solutions [K_W1; K_W2]
2. Knows and understands the most frequently used methods in the laboratory synthesis of bio-inspired materials [K_W1; K_W2]
3. Student knows the fundamental aspects of using 3D printing and electrospinning in biomimetic synthesis [K_W7; K_W18]

Skills:

1. The student is able to effectively use and integrate information obtained from literature and electronic sources, in Polish and English, to interpret and critically evaluate them [K_U1; K_U2]
2. Student manifests innovative and unconventional thinking in the design of materials and products, based on a thorough understanding of the structure of biomaterials at the nano; micro and macroscopic levels [K_U4; K_U3; K_U6]
3. Under the supervision of a research tutor, student is able to plan and perform research tasks using analytical, simulation and experimental methods [K_U6]

Social competences:

1. The student is ready to critically assess his knowledge, understands the need for training, supplementing the knowledge of the field and improving his professional competences [K_K1; K_K7]
2. Student think and acts creatively, presenting an unconventional and innovative approach to solving complicated technological problems [K_K7; K_K8; K_K9]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Students' skills acquired as part of the tutorial classes in both, stationary and remote (using ekursy platform) form are verified on the basis of the final test (stationary form of the test (colloquium) in writing; evaluation criteria: 3 - 50.1% -70.0%, 4 - 70.1% -90.0%, 5 - from 90.1%; remote form of the test (colloquium) in a multiple-choice test form using the ekursy platform; evaluation criteria: 3 - 50.1% - 70.0%, 4 - 70.1% -90.0%, 5 - from 90.1%;) and on the basis of the developed and submitted documentation from the project and case studies carried out during the course (exercise reports).

Programme content

The program includes the following topics:

1. Hybrid bioinspired nanostructures as next-generation materials.
2. Isolation of biomolecules from biominerals.
3. Inorganic molecules mimicking enzymes.
4. Biocatalysis and enzyme immobilization processes.

Course topics

Design and synthesis of hybrid bioinspired nanostructures as new generation materials
Isolation of biomolecules from biominerals

Inorganic molecules that mimic enzymes (basic information and examples)

Selected information on the biocatalysis and enzyme immobilization process, including the advantages and disadvantages of biocatalytic reactions, selected applications of enzymes and the definition and most important information on the enzyme immobilization process; presenting its advantages and disadvantages, as well as potential directions of practical application

Teaching methods

Lecture: multimedia presentation

Tutorials and case studies

Bibliography

Basic:

1. K. Konopka (2013) *Biomimetyczne metody wytwarzania materiałów*. Oficyna Wydawnicza Politechniki Warszawskiej

2. F.N. Kok (2019) *Biomimetic lipid membranes: fundamentals, applications and commercialization*. Springer International Publishing

3. J.F. Mano (2012) *Biomimetic Approaches for Biomaterials Development*. Wiley-VCH

4. E. Poupon, B. Nay (2003) *Biomimetic Organic Synthesis, 1&2*. Wiley-VCH Verlag GmbH

5. J. Zdarta, A.S. Meyer, T. Jesionowski, M. Pinelo, *Developments in support materials for immobilization of oxidoreductases: A comprehensive review*, *Advances in Colloid and Interface Science* 258 (2018) 1-20

Additional:

1. K. Konopka, *Wzorce z natury w technice i inżynierii materiałowej*. Oficyna Wydawnicza Politechniki Warszawskiej

2. X.Y. Liu, *Bioinspiration: from nano to micro scales*. Springer-Verlag New York, 2012

Breakdown of average student's workload

	Hours	ECTS
Total workload	30	1,00
Classes requiring direct contact with the teacher	15	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	15	0,50