



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Biomimetic materials and functional nanomaterials [S2TOZ1-TSO>MBiNF]

Course

Field of study

Circular System Technologies

Year/Semester

1/1

Area of study (specialization)

Renewable raw material technologies

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

15

Other

0

Tutorials

0

Projects/seminars

0

Number of credit points

2,00

Coordinators

dr hab. inż. Marcin Wysokowski
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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

Introduction of students to exemplary material and structural solutions developed by living organisms, along with a discussion of their hierarchical structure, properties, and the role they play in the organism. Presentation of the role of biopolymers as building materials in selected biological structures. Understanding the essence of biomimetics in the context of designing and synthesizing bio-inspired materials of the new generation. Designing the synthesis of bio-inspired materials using environmentally friendly solvents

Course-related learning outcomes

Knowledge:

1. Has advanced knowledge in mathematics, physics, chemistry, and other areas relevant to the studied

field, useful for describing and solving complex tasks related to the field of study [K_W01; K_W02].

2. Possesses detailed knowledge of technological solutions in environmental protection [K_W01; K_W02].

3. Has basic knowledge that allows planning, designing, and supervising the implementation of the latest technological solutions in environmental protection [K_W07; K_W18].

Skills:

1. The student is proficient in using and integrating information obtained from literature and electronic sources in both Polish and English, and can interpret and critically evaluate them [K_U1; K_U2].

2. Uses innovative and unconventional thinking in designing materials and products, based on a thorough understanding of biomaterials' structure at the nano-, micro-, and macroscopic levels [K_U4; K_U3; K_U6].

3. Under the supervision of a scientific advisor, can plan and carry out research tasks using analytical, simulation, and experimental methods [K_U06; K_U12].

4. Is able to communicate effectively with specialists in the field of environmental protection technology and related areas [K_U09].

5. Has the ability to selectively adapt knowledge from chemistry and related fields to plan and implement research tasks in the area of biomimetic solutions within circular economy technologies [K_U04; K_U03].

6. Can plan, prepare, and present a presentation on the execution of a research task and conduct a substantive discussion on the topic [K_U05].

7. Can formulate and test hypotheses related to the use of biomimetics and nanotechnology in circular economy technologies [K_U07].

Social competences:

The student is able to critically assess and verify the results of experimental research [K_K01].

The student can effectively use professional literature, integrate the information obtained, interpret and critically evaluate it, and formulate competent opinions and reports based on this [K_K01].

The student can analyze and critically evaluate new areas in environmental protection technologies, assess their innovativeness and technical feasibility [K_K01, K_K03].

The student is ready to critically assess their knowledge, understands the need for continuous learning, updating field-specific knowledge, and enhancing professional competencies [K_K03].

The student can think and act creatively, presenting unconventional and innovative approaches to solving technological problems [K_K04]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The skills acquired during the classes, whether in-person or online (using the eKursy platform), are assessed based on a final test (in-person: talk on specific topic; grading criteria: 3 - 50.1%-70.0%, 4 - 70.1%-90.0%, 5 - from 90.1%; online: multiple-choice test on the eKursy platform; grading criteria: 3 - 50.1%-70.0%, 4 - 70.1%-90.0%, 5 - from 90.1%), as well as through the submitted documentation of the experiments conducted (laboratory reports).

Programme content

Biomimetics, as a crucial field in circular economy technology, draws

Course topics

Introduction to biomimetics; hierarchical structure of biomaterials - linking chemistry, structure, and mechanical properties; bioadhesion and biomimetic adhesive materials; spider silk, chitin, collagen as substrates for the synthesis of advanced polymeric materials; the use of DNA in the synthesis of organized hybrid structures (DNA origami); inorganic nanoparticles mimicking enzymes; the application of electrospinning and 3D printing in the preparation of bio-inspired materials; biomimetics in environmental protection; biomimetics in the textile and aerospace industries

Teaching methods

presentation + laboratories

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. K.W. Szewczyk (2003) Technologia biochemiczna , Oficyna Wydawnicza Politechniki Warszawskiej.
5. E. Poupon, B. Nay (2003) Biomimetic Organic Synthesis, 1&2. Wiley-VCH Verlag GmbH

Additional:

6. K. Konopka, Wzorce z natury w technice i inżynierii materiałowej. Oficyna Wydawnicza Politechniki Warszawskiej
7. X.Y. Liu, Bioinspiration: from nano to micro scales. Springer-Verlag New York, 2012

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00