COURSE DESCRIPTION CARD - SYLLABUS

Course name
Biomimetic materials [S2TCh2-PTiB>MB]

Course

Field of study
Chemical Technology

Year/Semester
1/2

Area of study (specialization)
Technological Processes and Bioprocesses

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
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

dr 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

Main aim is to familarize 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 familirize 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, photonic and adhesive materials. Overview of the basics and perspectives of using 3D printing and electrospinning in biomimetic synthesis of materials. Presentation of market biomimetic products and solutions.

Course-related learning outcomes

Knowledge:
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_W01; KW_02)
Knows and understands the most frequently used methods in the laboratory synthesis of bio-inspired materials. K_W01; KW_02)
Student knows the fundamental aspects of using 3D printing and electrospinning in biomimetic synthesis (K_W04)

Skills:
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_U01; K_U02).
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_U04; K_U03; K_U06).
Under the supervision of a research tutor, student is able to plan and perform research tasks using analytical, simulation and experimental methods (K_U06)

Social competences:
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_K01; K_K07)
Student think and acts creatively, presenting an unconventional and innovative approach to solving complicated technological problems (K_K07; K_K08; K_K09).

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: credit

Programme content

Lecture
Fundamentals of biomimetics.
Hierarchical structure of biomaterials - interplay between chemistry, structure and mechanical properties.
Bio-optics and bio-inspired optical materials.
Bioadhesiveness and biomimetic adhesive materials.
Biomineralization as an inspiration for modern materials chemistry, architecture and industrial design.
Biomimetic approach to bone - a case study. Prospects for the synthesis of biomedical materials inspired by the bone structure.
Origami DNA: Platform to Create Organized Hybrid Structures.
Inorganic nanoparticles that mimic enzymes.
Design and synthesis of hybrid bio-inspired nanostructures as next-generation materials.
The use of electrospinning and 3D printing in the preparation of bio-inspired materials.

Teaching methods

Lecture: multimedia presentation.

Bibliography

Basic:
K. Konopka (2013) Biomimetyczne metody wytwarzania materiałów. Oficyna Wydawnicza Politechniki Warszawskiej
G. Pohl; W. Nachtigall (2015) Biomimetics for Architecture & Design. Springer International Publishing
J.F. Mano (2012) Biomimetic Approaches for Biomaterials Development. Wiley-VCH

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

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	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)	10	0,50