COURSE DESCRIPTION CARD - SYLLABUS

Course name
Biomimetic systems engineering [S1Bioinf1>IUB]

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
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of physics, organic chemistry, physical chemistry of physical and biochemical processes; knowledge of cell biology; general academic-level math skills, basic knowledge of laboratory equipment and safety rules in a chemical laboratory

Course objective

The aim of course is to gain the knowledge and skills in the field of biomimetic systems engineerging which allow to solve complex engineering problems and manufacture products inspired by nature.

Course-related learning outcomes

Knowledge:
A graduate knows and understands:
- chemistry issues required to formulate and solve simple bioinformatic problems including basic definitions and laws of chemistry, organic chemistry and biochemistry (KW_04)

- selected groups of bioactives, their biochemical properties and impact on cells and living organisms (KW_08)
- modern analytical methods used for the evaluation of properties and structure of biomaterials and biomimetic materials (KW_016)

Skills:
A graduate is able to:
- use basic techniques and laboratory tools to solve the problems in the field of bioinformatics, biotechnology and related fields and to evaluate their usability (KU_05);
- integrate and interpretate information gained, draw the conclusions and formulate and explain his/her own opinions (K_U02)
- use analytical, simulation and experimental tools under the supervision of scientific tutor to formulate and solve reserach tasks (KU_07);

Social competences:
A graduate is ready to:
- cooperate and work in team taking various roles (K_K02);
- identify priorities in acomplishing the tasks set by him/herfself or by the other person (K_K03) ;
- take the responsibility for his/her and other person"s safety and make the appropriate decisions responding on an emergency (K_K06)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture classes:
Written exam graded in the range 0-100 pts and the following scale is assumed:
3 50,1-60,0 %
3.5 60,1-70%
4 70,1-80,0 %
4.5 80,1-90 %
5 90,1-100 %
Additional points might be earned for active participation in the lectures.
Laboratory classes:
current evaluatoin of student"s knowledge before each class and grading the reports with the results of laboratory experiments.

Programme content

The course program covers interdisciplinary topics related to mimicking patterns found in nature in nanotechnology, engineering, medical bioengineering, and other related fields."

Course topics

1. The concept of biomimetic systems, characterization of biomimetic technical solutions.
2. Biomimetic systems engineering in the light of innovation and sustainability.
3. Biological materials vs. engineering materials.
4. Design, modeling and manufacturing of biomimetic materials (top-down and bottom-up strategies, structural, functional and process biomimetic materials).
5. Physical chemistry of interfacial phenomena in biomimetic systems (surface tension, adhesion, properties of colloidal systems, wettability, adsorption, surface reactions).
6. Bioinspired materials and nanomaterials (superhydrophobic, superhydrophilic, self-cleaning, self-healing ,smart materials, self-assembling materials).
7. Experimental methods in studying biomimetic systems.
8. Model biomembranes of living cells: liposomes, Langmuir and Langmuir-Blodgett films, in vitro evaluation of impact of drugs, toxins and other substances on living organisms.
9. Design of biomimetic systems of defined otpical, adhesive and responsive properties.
10. Biomimetic strategies in engineering and bioengineering
Laboratory classes are practical excersisces related to the content of the lecture.

Teaching methods

Lecture: Presentation, discussion and quiz
Laboratory classes: practical excercices made by students in physicochemical laboratory.

Bibliography

Basic
1. K. Konopka, Biomimetyczne metody wytwarzania materiałów, Wyd. Politechniki Warszawskiej 2013.
2. K. Dołowy, A. Szewczyk, S. Pikuła Błony biologiczne, Wyd. Śląsk, 2003.
3. J. Bar-Cohen, Biomimetics: Biologically Inspired Technologies, CRC Press, 2005.
4. G. F. Swiegers, Bioinspiration and Biomimicry in Chemistry: Reverse ‐ Engineering Nature, John Wiley & Sons Ltd., 2012
Additional
1. A. UIman, Ultrathin organic films, Academic Press, 1991.
2. M. Petty, Langmuir-Blodgett films, Cambridge University Press, 2009.
3. Z. Xia, Biomimetic Principles and Design of Advanced Engineering Materials, John Wiley & Sons Ltd., 2016.
4. Dopierała K., Krajewska M., Weiss M., Physicochemical Characterization of Oleanolic Acid-Human Serum Albumin Complexes for Pharmaceutical and Biosensing Applications, Langmuir 36, 13, 2020, pp.3611–3623
5. M. Rojewska, M. Skrzypiec M., K. Prochaska, The wetting properties of Langmuir–Blodgett and Langmuir–Schaefer films formed by DPPC and POSS compounds, Chemistry and Physics of Lipids, 221, 158-166 (2019)
6. M. Skrzypiec M., M. Weiss, K. Dopierała, K. Prochaska, Langmuir-Blodgett films of membrane lipid in the presence of hybrid silsesquioxane, a promising component of biomaterials, Materials Science & Engineering C, 105 (2019) 110090;
7. L. Massaron , A. Boschetti Python. Podstawy nauki o danych. Wyd. II, Helion

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50