COURSE DESCRIPTION CARD - SYLLABUS

Course name
Transport processes in biological systems [S2IChiP1-IBiB>PTwUB]

Course

Field of study
Chemical and Process Engineering

Year/Semester
1/2

Area of study (specialization)
Bioprocesses and Biomaterials Engineering

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
30

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
30

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of heat and mass transport theory. Ability to solve differential equations.

Course objective

Expanding knowledge in the field of basic chemical engineering operations. A look at the processes occurring in biological systems from the point of view of chemical and process engineering. Improving mathematical modeling skills.

Course-related learning outcomes

Knowledge:
1. has extended and in-depth knowledge in mathematics and computer science necessary for modeling, planning, optimization and characterization industrial chemical processes as well as planning experiments and development results of experimental research - k_w01

2. has expanded knowledge of physics to understand processes
physical, related to chemical engineering - k_w02

Skills:
1. has the ability to obtain and critically evaluate information from literature,
databases and other sources, and formulating opinions and reports on this basis - k_u01
2. is able to use professional software, using them for
designing chemical processes and process installations -k_u07
3. has the ability to analyze and solve problems related to technology
chemical and process engineering using methods for this purpose
theoretical, analytical, simulation and experimental - k_u09
4. can properly use natural resources in industry, following the principles of environmental protection
and sustainable development - k_u12

Social competences:
1. understands the need for lifelong learning; can inspire and organize
other people"s learning process; is aware of validity and non-technical
aspects and effects of engineering activities, including its impact on
environment, and the associated responsibility for decisions taken - k_k01
2. is able to properly define the priorities for implementation specified by
yourself or other tasks - k_k04

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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1. The knowledge and skills acquired during the lecture are verified in a written exam, stationary or on - line (eKursy platform), depending on the mode of conducting classes. The exam consists of one theoretical question (0-40 points) and two accounting tasks (0-30 points each). Ratings: 3
50.1 -70.0 points
4 70.1 -90.0 points
5 90.1 -100 points.
2. Knowledge, skills and competences during project classes are verified on the basis of projects made in teams of two. The project includes: formulation of the task of simultaneous mass and heat transport, theoretical development of the problem, formulation of equations and boundary conditions, selection of a numerical algorithm and program implementation. The project is defended stationary or online, depending on the mode of conducting the classes.

Programme content

1. Review of heat and mass transport processes in living organisms, in the natural environment and in materials of biological origin.
2. General energy transport equations and boundary conditions, biological context of equations, interpretation of individual equation terms and boundary conditions in the context of biomaterials and the environment. Equations in various coordinate systems.
3. Steady state heat conduction, metabolic processes as a heat source. Solved problems for different geometries. Microwave heating effect.
4. Modeling of convective heat exchange processes in biological systems. Convective heat exchange in an incubator. Regulation of mammalian body heat under convective heat exchange conditions with the environment.
5. Heat and mass exchange combined with phase changes. Modeling of freezing and thawing bioproducts. Lyophilization, cryosurgery.
6. Heat transfer by radiation: basic information about electromagnetic waves, reflection, absorption and transmission of waves on the surface, leaf permeability and photosynthesis, atmospheric permeability: greenhouse effect. Absorption and transmission in biomaterials, solar, atmospheric and surface radiation, radiation exchange between humans (or animals) and their surroundings.
7. Modeling of mass transport processes in biomaterials: oxygen diffusion in soil, water and CO2 transport in leaves during photosynthesis, controlled dosing of drugs, dialysis, transport of pollutants in soil and in the air.
8. Problems of the simultaneous transport of mass and heat. Problems for coupled temperature and

moisture content fields: equations, boundary conditions and problem solving algorithms.

Teaching methods

Lecture: multimedia presentation, illustrated with examples on the board.
Project: tasks in the field of materials presented in lectures solved with the support of the MathCad package.

Bibliography

Basic
1. Kowalski S.J., Procesy transportu ciepła i masy, Wyd. Politechniki Poznańskiej, 2011
2. Cz. S.Wiśniewski, Wymiana ciepła, WNT, Warszawa1979.
3. Strumiłło, Podstawy teorii i techniki suszenia, WNT, Warszawa 1983.
Additional
1. A. ÇENGEL, A.J. GHAJAR, HEAT AND MASS TRANSFER: FUNDAMENTALS & APPLICATIONS, FIFTH
EDITION Published by McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121. 2015
2. C.O.Bennett, J.E.Myers, Przenoszenie pędu, ciepła i masy, WNT, Warszawa 1967.
3. ASHIM K. DATTA Heat and mass transfer.Biological Context. Second Edition CRC Press 2017. London New York.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
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)	15	0,50