COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fundamentals of process engineering [S1TOZ1>PIP]

Course

Field of study	Year/Semester
Circular System Technologies	2/4
Area of study (specialization)	Profile of study
–	general academic
Level of study	Course offered in
first-cycle	Polish
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other
45	30	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

6,00

Coordinators

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Lecturers

Prerequisites

The student has a basic knowledge of mathematics, physics and chemistry obtained during classes at the first grade of study, enabling understanding of physical and chemical phenomena in the field of heat and mass exchange and their mathematical description. Is able to acquire and supplement information on chemistry, physics and mathematics from academic textbooks and other books, has the ability to self-education, can work individually and in a team, plan and carry out experiments, interpret results and draw conclusions, can apply the principles of health and safety related to work. Understands the need for continuous training and setting ambitious goals on the way to achieve higher education, is aware of the responsibility for tasks carried out in team work.

Course objective

Obtaining knowledge in the field of modeling and designing flow and heat processes and apparatus for the implementation of processes in the field of chemical and process engineering in the laboratory scale and the ability to transfer results to the scale of the prototype on a real scale.

Course-related learning outcomes

Knowledge:

1. has extended and in-depth knowledge of mathematics necessary for modeling, planning, optimization and characterization of processes in engineering practice as well as planning experiments and developing the results of experimental research - k_w01.
2. has extended knowledge of physics allowing for understanding of physical processes related to process engineering - k_w02.
3. has basic knowledge of devices and installations used in circular system technologies - k_w12.
4. has knowledge of the basis of physical unit operations of circular system technologies - k_w22.
5. has knowledge of heat, mass and momentum exchange processes - k_w23.

Skills:
1. has the ability to obtain and critically evaluate information from literature, databases and other sources, and to formulate opinions and reports on this basis - k_u01.
2. can pursue self-education, prepare in polish and english a problem study related to the field of study - k_u04.
3. can plan and organize work individually and in a team - k_u08.
4. can make mass and energy balances of unit processes in circular system technologies - k_u17.
5. can, with the use of analytical and experimental methods, formulate assumptions and methods of their implementation for simple engineering tasks in the design of circular system installations - k_u22.

Social competences:
1. acts in accordance with the moral principles and the principles of professional ethics - k_k01.
2. can think and act in a creative and entrepreneurial manner - k_k06.
3. has a well-shaped awareness of the limitations of science and technology related to the protection of the natural environment and is aware of the negative impact of humans on the state of the environment - k_k10.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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The knowledge acquired during the lecture is verified by a written exam covering the entire knowledge of the subject in the stationary or on-line form, depending on the method of conducting classes. It consists of 15 questions. Passing threshold: 50% of points. The completion of the questions on the basis of which the questions are developed will be sent to students using the eLearning platform - eKursy.
Passing the laboratory on the basis of the assessment of the current work during laboratory classes and a written knowledge check before the laboratory classes.

Programme content

Basics of process engineering, flow, heat and diffusion, humid air thermodynamics, energy efficiency.

Course topics

This course covers the basics of process engineering, with the discussed issues divided into flow, thermal and diffusion processes. Flow processes include the problems of fluid and gas flow with the use of concepts and assumptions of fluid mechanics. The scope of considerations in this topic covers the mechanics of incompressible fluids and real fluids with regard to fluid viscosity. Thermal processes include conduction, convection, and radiation. The issues of heat transfer, heat movement with free and forced convection and the principles of designing heat exchangers are presented. Elements of humid air thermodynamics and the basics of the theory of filtration and filtering are also discussed. Diffusion processes relate to the flow of multicomponent fluids. The established and transient diffusion problems, the basics of convective mass flow and the principles of designing mass exchangers are presented. The problems of simultaneous heat and mass exchange are also discussed. The mathematical description of the processes uses the differential and integral calculus as well as the principles of dimensional analysis and the theory of similarity.
The above-mentioned basic elements will be discussed within the broader context of the circular economy. An overview of energy policy is foreseen based on examples and related unit processes. The following issues will be discussed: energy efficiency - zero-energy buildings, passive buildings, building insulation, thermal comfort, dew point, dampness of walls and roofs of buildings; cogeneration -

simultaneous generation of heat and electricity; renewable energy sources - production of zero-emission energy for the purposes of the technological process and the associated no need to use emission sources (photovoltaic power plants, solar-heliostats, wind farms on land and sea (windmills with horizontal and vertical axis of rotation), biomass power plants powered by waste products, pumped storage power plants and the energy balance of a simple example of a pumped storage power plant, geothermal power plants - deep geothermal energy and its location and technological limitations, shallow geothermal energy - heat pumps); reducing emissions - absorption and recycling of by-products - for energy policy the use of waste heat - recuperators and heat exchangers.

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples solved on the blackboard.
2. Laboratory classes: practical exercises.

Bibliography

Basic
1. Kowalski S.J., Teoria procesów przepływowych cieplnych i dyfuzyjnych, Wydawnictwo Politechniki Poznańskiej, Wyd. 1999 oraz 2008.
2. Kembłowski Z., Michałowski S., Strumiłło Cz., Zarzycki R., Podstawy teoretyczne inżynierii chemicznej i procesowej, Warszawa, PWN 1985.
3. Malczewski J., Piekarski M., Modele procesów transportu masy, pędu i energii, Warszawa, PWN 1992.
4. Zadania projektowe z inżynierii procesowej, Biń A., Huettner M., Kopeć J., Kozłowski M., Nowosielski J., Sieniutycz S., Szembek-Stoeger M., Szwast Z., Wolny A., Wyd. Politechniki Warszawskiej 1986.
5. Ciborowski, J., Inżynieria procesowa, Warszawa, WNT 1973.
6. Hobler T., Ruch ciepła i wymienniki, wyd. 4, Warszawa, PWN 1971.
7. Bennet C.O., Myers J.E., Przenoszenie pędu, ciepła i masy, Warszawa, WNT 1962.
8. Wiśniewski S., Wiśniewski T.S., Wymiana ciepła, Warszawa, WNT 2000.
9. Popkiewicz M., Rewolucja energetyczna, ale po co?, Katowice, Sonia Draga 2015.

Additional
1. Brodowicz K., Teoria wymienników ciepła i masy, PWN-Warszawa, 1982.
2. Malczewski J., Piekarski M., Modele procesów transportu masy, pędu i energii, PWN-Warszawa, 1992.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	76	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	74	3,00