



Subject card

Subject name and code	Diffusive processes in chemical engineering, PG_00060872							
Field of study	Chemical Technology							
Date of commencement of studies	October 2024	Academic year of realisation of subject		2026/2027				
Education level	first-cycle studies		Subject group		Obligatory subject group in the field of study Subject group related to scientific research in the field of study			
Mode of study	Full-time studies		Mode of delivery		at the university			
Year of study	3	Language of instruction		Polish				
Semester of study	6	ECTS credits		4.0				
Learning profile	general academic profile		Assessment form		assessment			
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology							
Name and surname of lecturer (lecturers)	Subject supervisor Teachers		dr inż. Iwona Hołowacz					
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM	
	Number of study hours	15.0	0.0	30.0	15.0	0.0	60	
E-learning hours included: 0.0								
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM	
	Number of study hours	60		10.0		50.0	120	
Subject objectives	To familiarize students with the concepts of diffusion operation/mass transfer and heat-mass transfer processes . Presenting students the opportunities to use mathematical equations in the description of the unit operations used in bioprocess engineering. Developing students' computing skills for the relevant unit operations.							

Learning outcomes	Course outcome	Subject outcome	Method of verification												
	[K6_U06] is able to select the chemical and technological concept of the production method, is able to justify the suitability of the raw materials used, analyses and evaluates the quality of the products obtained, critically analyses the functioning of existing technical solutions and evaluates these solutions	identifies diffusion processes in a given technology; explains the connections between the physicochemical balance of the system and the course of selected diffusion operations used to obtain chemical products.	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information												
	[K6_W06] has knowledge of information technology and computer-aided design, the use of databases in technological design	demonstrate knowledge in the use of mathematical tools and physicochemical data to calculate and analyze the course of selected diffusion operations in chemical engineering.	[SW3] Assessment of knowledge contained in written work and projects												
	[K6_U04] performs basic design calculations of selected processes and unit operations, is able to calculate and select the basic apparatus of chemical industry in a process line	is able to describe mass transfer processes, indicate the driving force of the process, and prepare a mass balance of selected processes; is able to perform calculations of selected unit processes.	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject												
	[K6_K05] is aware of the social role of a technical university graduate, and in particular understands the need to formulate and communicate to the public, in particular through the mass media, information and opinions on the achievements of technology and other aspects of engineering activity	understand that as a specialist, they have an impact on society and feel responsible for their actions. They are aware of the need to communicate with the public, including through mass media, to present engineering achievements in an accessible manner.	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work												
	[K6_W04] understands processes occurring in the life cycle of equipment and facilities and has knowledge of mechanical engineering, chemical apparatus, technical thermodynamics and chemical engineering and chemical reactor engineering necessary to analyse technological processes and correctly design installations and systems in the chemical industry	explains the principle of separating mixtures using diffusion operations such as absorption, extraction, distillation, rectification and drying; demonstrates preparation in the use of methods of learned operations to separate chemical products.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects												
Subject contents	<p>Course content – lecture</p> <p>The mass exchange. The basic law of diffusion. Mass transfer coefficients and overall mass transfer coefficients. Absorption, number of theoretical plates, the efficiency of the plate, the height of the column packing layer. Absorption with recirculation of the solvent. Differential and equilibrium distillation. Cocurrent and countercurrent condensation. Rectification, number of theoretical plates, method of McCabe and Thiele'a, the efficiency of the plate, the height of the column packing layer, deflegmator column. Extraction of single-stage. Co-current multistage extraction. Multistage countercurrent extraction. Drying of porous solids. Parameters of the drying air. The equilibrium and kinetics of drying.</p> <p>Course content – laboratory</p> <p>Countercurrent absorption. Rectification. Drying of porous solids. Fluidization.</p> <p>Course content – project</p> <p>Continuous rectification: material and heat balances, number of theoretical and actual plates, number of mass transfer units, flooding rate. Single-stage, cocurrent, and countercurrent extraction. Countercurrent absorption: material balance, number of mass transfer units, flooding rate.</p>														
Prerequisites and co-requisites	Properties of liquids and gases. Physicochemical equilibria: liquid-vapor, liquid-liquid, gas-liquid. Differential and integral calculus. Knowledge of the construction and operation of typical apparatus and machines used in the chemical and related industries.														
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr> </thead> <tbody> <tr> <td>written test</td><td>60.0%</td><td>50.0%</td></tr> <tr> <td>tests and design task</td><td>60.0%</td><td>25.0%</td></tr> <tr> <td>tests and reports</td><td>60.0%</td><td>25.0%</td></tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	written test	60.0%	50.0%	tests and design task	60.0%	25.0%	tests and reports	60.0%	25.0%
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Recommended reading	Basic literature	<p>M. Serwiński: Zasady inżynierii chemicznej. WNT 1982.</p> <p>A. Selecki, L. Gradoń: Podstawowe procesy przemysłu chemicznego. WNT 1985.</p> <p>P. Lewicki: Inżynieria procesowa i aparatura przemysłu spożywczego. WNT 2005</p> <p>R. Zarzycki: Wymiana ciepła i ruch masy w inżynierii środowiska. WNT 2010</p> <p>D. Konopacka-Łyskawa (red.): Inżynieria chemiczna i procesowa wybrane zagadnienia, Wydawnictwo PG, Gdańsk, 2022.</p> <p>D. Konopacka-Łyskawa (red.): Podstawy inżynierii chemicznej i procesowej, Wydawnictwo PG 2012</p> <p>I. Hołowacz (red.): Przykłady i zadania z podstaw inżynierii chemicznej i procesowej, Wydawnictwo PG 2017</p> <p>D. W. Green (ed.): Perry's Chemical Engineers' Handbook, The McGraw-Hill Comp. Inc. (8th ed.) 2008.</p>
	Supplementary literature	<p>Z. Ziołkowski: Ekstrakcja cieczy w przemyśle chemicznym, WNT 1980.</p> <p>Z. Ziołkowski: Destylacja i rektyfikacja w przemyśle chemicznym, WNT 1980.</p> <p>C. Strumiłło: Podstawy teorii i techniki suszenia, WNT 1983.</p> <p>R. Zarzycki: Zadania rachunkowe w inżynierii chemicznej, PWN 1980.</p> <p>K. Pawłowski: Przykłady i zadania z zakresu aparatury i inżynierii chemicznej, WNT 1981</p> <p>W.L. McCabe, J.C. Smith: Unit operations of chemical engineering, The McGraw-Hill Comp. Inc. (7th ed.) 2005.</p>
	eResources addresses	
Example issues/ example questions/ tasks being completed	<p>1. Countercurrent absorption with solvent recirculation: column diagram, principle of operation, derive the operating line equation based on the mass balance of the upper part of the column, explain the method of determining the minimum and actual solvent consumption based on the $Y = f(X)$ chart. Explain how to determine the column height based on the number of theoretical plates and the number of mass transfer units in the liquid phase.</p> <p>2. Define the concept of volatility and relative volatility for a two-component mixture. Give the equation describing the relationship between the composition of the liquid and gas phases for systems applying Raoult's law. Present a diagram of the simple distillation process and describe the principle of operation of the presented system. Show on the graph in the system $t = f(x, y)$ and $y = f(x)$ the course of this process (known feed composition). Write the material balance of the process and the Rayleigh equation. Determine the average composition of the resulting distillate.</p> <p>3. Draw the drying rate curve. Identify its characteristic sections, and for each section, indicate the appropriate solid moisture ranges, and explain what determines the drying rate.</p>	
Practical activites within the subject	Not applicable	

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