GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Diffusive processes in chemical engineering, PG_00060872		
Field of study	Chemical Technology		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
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	dr inż. Iwona Hołowacz	
	Teachers		

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 transter 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_W04] Possesses the technical knowledge necessary to analyze processes and design installations 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
[K6_U04] Is able to recognize and apply polymer processing methods, analyze corrosion processes of construction materials in the design of installations, taking into account systemic and non-technical aspects.	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 [SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task
[K6_U06] Recognizes the relationships between technological issues and their impact on the environment, taking into account the principles of sustainable development, systemic and non-technical aspects, and occupational health and safety principles	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.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools

<table>
<tr><td>Subject contents</td><td>Course content – lecture
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.
Course content – laboratory
Countercurrent absorption. Rectification. Drying of porous solids. Fluidization.
Course content – project
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.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>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.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>tests and design task</td><td>60.0%</td><td>25.0%</td></tr>
<tr><td>written test</td><td>60.0%</td><td>50.0%</td></tr>
<tr><td>tests and reports</td><td>60.0%</td><td>25.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>M. Serwiński: Zasady inżynierii chemicznej. WNT 1982.
A. Selecki, L. Gradoń: Podstawowe procesy przemysłu chemicznego. WNT 1985.
P. Lewicki: Inżynieria procesowa i aparatura przemysłu spożywczego. WNT 2005
R. Zarzycki: Wymiana ciepła i ruch masy w inżynierii środowiska. WNT 2010
D. Konopacka-Łyskawa (red.): Inżynieria chemiczaj i procesowa wybrane zagadnienia, Wydawnictwo PG, Gdańsk, 2022.
D. Konopacka-Łyskawa (red.): Podstawy inżynierii chemicznej i procesowej, Wydawnictwo PG 2012
I. Hołowacz (red.): Przykłady i zadania z podstaw inżynierii chemicznej i procesowej, Wydawnictwo PG 2017
D. W. Green (ed.): Perry's Chemical Engineers' Handbook, The McGrow-Hill Comp. Inc. (8th ed.) 2008.</td></tr>
<tr><td>Supplementary literature</td><td>Z. Ziołkowski: Ekstrakcja cieczy w przemyśle chemicznym, WNT 1980.
Z. Ziołkowski: Destylacja i rektyfikacja w przemyśle chemicznym, WNT 1980.
C. Strumiłło: Podstawy teorii i techniki suszenia, WNT 1983.
R. Zarzycki: Zadania rachunkowe w inżynierii chemicznej, PWN 1980.
K. Pawłow i in.: Przykłady i zadania z zakresu aparatury i inżynierii chemicznej, WNT 1981
W.L. McCabe, J.C.Smith: Unit operetions of chemical engineering, The McGrow-Hill Comp. Inc. (7th ed.)2005.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>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.
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.
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.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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