



Subject card

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|---|---|--|-------------------------------------|------------|---|--|-----|
| Subject name and code | Diffusive processes in chemical engineering, PG_00060872 | | | | | | |
| Field of study | Chemical Technology | | | | | | |
| Date of commencement of studies | October 2026 | Academic year of realisation of subject | | | | 2028/2029 | |
| 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 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_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 | | |

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| Subject contents | 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. | | | |
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| 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 | Subject passing criteria | | Passing threshold | Percentage of the final grade |
| | tests and design task | | 60.0% | 25.0% |
| | written test | | 60.0% | 50.0% |
| | tests and reports | | 60.0% | 25.0% |
| Recommended reading | Basic literature | 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 chemiczna 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 McGraw-Hill Comp. Inc. (8th ed.) 2008. | | |
| | Supplementary literature | 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. Pawłó i in.: Przykłady i zadania z zakresu aparatury i inżynierii chemicznej, WNT 1981 W.L. McCabe, J.C.Smith: Unit operations of chemical engineering, The McGraw-Hill Comp. Inc. (7th ed.)2005. | | |
| | eResources addresses | | | |
| Example issues/ example questions/ tasks being completed | 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. | | | |
| Practical activities within the subject | Not applicable | | | |

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