GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Chemical and Bioprocess Engineering, PG_00037411		
Field of study	Biotechnology		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2022/2023
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	exam
Conducting unit	Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Donata Konopacka-Łyskawa	
	Teachers	dr inż. Iwona Hołowacz dr inż. Piotr Rybarczyk dr hab. inż. Donata Konopacka-Łyskawa dr inż. Karolina Kucharska	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	30.0	0.0	90

E-learning hours included: 0.0

Additional information:
lecture: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=4225

project: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=4236

laboratory: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=5444+

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	90	6.0	24.0	120

Subject objectives

Familiarize students with the basic concepts of the mass exchange. Presenting students the opportunities to use mathematical equations in the description of the unit operations used in the chemical and bioprocess engineering. Developing students' computing skills for the relevant unit operations.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W08	The student knows the use of mass transfer processes in the preparation of biotechnological products.	[SW2] Assessment of knowledge contained in presentation
K6_U02	The student is able to describe mass transfer processes and point out their driving force, as well as derivative mass balances of selected systems. Student performs basic calculations of selected unit processes.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
K6_W10	The student has basic knowledge of mass transfer in multiphase systems. The student understands the basic concepts related to mass transfer processes.	[SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation

Subject contents	Differential distillation, equilibrium distillation, and steam distillation. Co-current and countercurrent condensation. Continuous rectification: mass and heat balances, number of theoretical plates, condensers, plate efficiency, height of the packed bed. Batch rectification: at a constant distillate composition and at a constant reflux. Counter-current absorption, counter-current absorption with recirculation of the solvent; co-current absorption; number of theoretical plates; the efficiency of the plate; height of the packed bed. Extraction: single contact extraction, co-current multi-stage extraction, multi-stage countercurrent extraction, extraction with mutual insoluble solvents. Drying of porous solids: parameters of humid air, equilibrium and kinetics of drying. Crystallization.
Prerequisites and co-requisites	Properties of liquids and gases. Basic knowledge of physical chemistry - physico-chemical equilibria and diffusion.
Assessment methods and criteria	(see table below)

Subject passing criteria	Passing threshold	Percentage of the final grade
Written tests	60.0%	20.0%
Written egzam	60.0%	30.0%
Project	60.0%	25.0%
Laboratory	100.0%	25.0%

Recommended reading

Basic literature	1. R. Zarzycki: Wymiana ciepła i ruch masy w inżynierii środowiska, WNT 2010. 2. M. Serwiński: Zasady inżynierii chemicznej, WNT 1982. 3. P. Lewicki (red.): Inżynieria procesowa i aparatura przemysłu spożywczego, WNT 2005. 4. A. Selecki, L. Gradoń: Podstawowe procesy przemysłu chemicznego, WNT 1985. 5. W. L. McCabe, J. C. Smith, P. Harriot, Unit operations of chemical engineering, McGrow-Hill Comp. Inc. (7th ed.) 2005 6. D. W. Green (ed.): Perry's Chemical Engineers' Handbook, The McGrow-Hill Comp. Inc. (7th ed.) 1997.
Supplementary literature	1. Z. Ziołkowski: Destylacja i rektyfikacja w przemyśle chemicznym, WNT 1980. 2. C. Strumiłło: Podstawy teorii i techniki suszenia, WNT 1983. 3. P. Synowiec: Krystalizacja przemysłowa z roztworu, WNT 2008. 4. D. Konopacka-Łyskawa (red.): Podstawy inżynierii chemicznej i procesowej, Wydawnictwo PG 2012. 5. I. Hołowacz (red.): Przykłady i zadania z podstaw inżynierii chemicznej i procesowej, Wydawnictwo PG 2017.
eResources addresses	Adresy na platformie eNauczanie: Inżynieria chemiczna i bioprocesowa - projekt - 2022/23 - Moodle ID: 26112 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26112 Inżynieria chemiczna i bioprocesowa - projekt - 2022/23 - Moodle ID: 26112 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26112 Inżynieria chemiczna i bioprocesowa - projekt - 2022/23 - Moodle ID: 26112 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26112

Example issues/ example questions/ tasks being completed	1. Explain the operation of condensers a / fully condensing, b / co-current partially condensing and c / counter-current partly condensing . Using the charts t = f (x, y), y * = f (x) indicate the product compositions for the selected composition of the vapour entering the condenser. Draw flows of liquid and vapor streams during partial counter-current condensation and write the mass balance of the streams, the mass balance of the more volatile component and the mass balance of a differential portion of vapour. Show that the counter-current condenser is more effective than one theoretical plate. 2. Draw a scheme of the column for continuous rectification. Based on the used symbols in the drawing, write the material and heat balance. Specify the thermal state of the feed, indicate the possible values for the five distinguished thermal states of feed . Discuss impact of the feed condition on a / the position of the inlet plate in the rectification column - justify the answer with the appropriate diagrams; b / the liquid and vapor stream at the top and bottom of the column based on the appropriate balance relationships. Discusse the amount of heat received in the condenser and delivered to the boiler change if the reflux decreases? 3.Draw a diagram of the absorption column. Write the mass balance of the absorbed component for this process. Based on the use symbols, determine the volume of gas introducing to the column. a / Draw the equilibrium line and the operating line for the process in which the minimum amount of absorbent was used on the exemplary equilibrium; b / on the same chart draw the operating line for the same amount of absorbent was used, but a lower degree of absorption was achieved; c / Write the equation of operating lines for the processes describe in points /a/ and / b /; d / Determine the excess of solvent in relation to the minimum amount for absorption from point / b /. Write the dependence on the number of mass transfer units in the gas phase; explain the meaning of the variables in the appropriate chart. How will the number of mass transfer units change if the consumption of absorbent increases? 4. Draw a scheme of counter-current extraction and write the material balance for the whole process and for the third stage of this extraction, when the secondary solvent B is contaminated with component C (B with a small proportion of component C). Explain a) using the Gibbs triangle to determine the minimum and maximum amount of solvent in countercurrent extraction; b) how to determine the mass and composition of the extract and raffinate produced in the second extraction stage. Present the process of counter-current multi-stage extraction in a rectangular diagram when solvent B contains a small amount of component C. Indicate the change of the concentration of the component extracted on the second theoretical plate? Explain the concept of theoretical plate in extraction.
Work placement	Not applicable