GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00037592		
Field of study	Green Technologies		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2022/2023
Education level	first-cycle studies	Subject group	Optional subject group 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	2	Language of instruction	English
Semester of study	4	ECTS credits	7.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Donata Konopacka-Łyskawa	
	Teachers	dr inż. Piotr Rybarczyk dr hab. inż. Donata Konopacka-Łyskawa	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	45.0	0.0	105

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	105	5.0	65.0	175

Subject objectives

To familiarize students with the basic concepts of selected dynamic operations (fluid flows, filtration, settling of particles), the heat exchange and the mass exchange. Presenting students the opportunities to use mathematical equations in the description of the unit operations used in proces engineering. Developing students' computing skills for the relevant unit operations.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U05] can formulate and solve engineering tasks analytical methods, simulation as well as experimental, able to apply knowledge of basic physics and mathematics to analyze the results of experiments, is able to analyze and assess existing technical solutions	Student is able to: indicate the sources of fluid pressure losses in the installation, describe ways of heat transfer and mass transfer, indicate the driving force of processes. Student is able to select a pump, a filter, a heat exchanger and a mass exchanger. The student is able to perform basic calculations of selected unit processes.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
[K6_W06] has a basic knowledge of chemical engineering, mechanical engineering and chemical equipment, knows and understands basic processes taking place in green, proenvironmental technologies	Student understands and explains fundamental definitions of dynamic operations, heat exchanges of mass transfer processes in the environmental protection and engineering. Student knows and recognizes basic apparatus used in selected unit operations.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
[K6_K01] understands the need for learning throughout life, can inspire and organize the learning process of others. Is aware of his/her own limitations and knows when to ask the experts, can properly identify priorities for implementation, critically evaluate his knowledge	The student can organize his learning process to develope mini-projects, projects and laboratory exercises.	[SK4] Assessment of communication skills, including language correctness [SK3] Assessment of ability to organize work [SK5] Assessment of ability to solve problems that arise in practice [SK1] Assessment of group work skills

Subject contents	Fundamentals of fluid statics. Flow of ideal fluids, Bernoulli's equation. Flow of real fluids: laminar and turbulent flow. Flow resistance in the tubes and through a packed bed. Type of pumps. Free settling. Hydraulic classificator. Dust settling chamber. Filtration under a constant pressure. Types of filters. Heat transfer: heat conduction, free and forced convection, radiation. Heat exchangers. Countercurrent absorption, countercurrent absorption with recirculation of the solvent; number of theoretical plates; the efficiency of the plate; height of the packed bed. Extraction: single contact extraction, co-current multistage extraction, multi-stage countercurrent extraction. Drying of porous solids: parameters of humid air, equilibrium and kinetics of drying.
Prerequisites and co-requisites	Knowlege of the properties of liquids and gases. Basic knowlege of physical chemistry.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
lecture tests	60.0%	20.0%
mini-projects and project	60.0%	30.0%
laboratorium	100.0%	30.0%
written exam	60.0%	20.0%

Recommended reading

Basic literature	1. Unit operations in chemical engineering, 7th ed., W. L. McCabe, J. C. Smith, P. Harriott (McGrow Hill Inc. 2005) 2. Basic Principles and Calculation in Chemical Engineering , 6th ed., D. M. Himmelblau (Prentice Hall PTR 1996) 3. Handbook of Chemical Engineering Calculations, 4th ed. 2012 (McGrow Hill)
Supplementary literature	1. D. W. Green (ed.): Perry's Chemical Engineers'Handbook, The McGrow-Hill Comp. Inc. (7th ed.) 1997 2. S. Katoh, J.Horiuchi, F. Yoshida: Biochemical engineering, Wiley 2015 3. J. D. Seader, E. J. Henley, D. K. Roper: Separation process principles, Wiley 2011
eResources addresses	Adresy na platformie eNauczanie: Process engineering and chemical equipment - lab -2022/23 - Moodle ID: 26119 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26119 Process engineering and chemical equipment - lab -2022/23 - Moodle ID: 26119 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26119 Process engineering and chemical equipment - lab -2022/23 - Moodle ID: 26119 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26119

Example issues/ example questions/ tasks being completed	1. Draw the injector. Show the way how to calculate the pressure in the smaller cross-section, if diameters of larger and smaller cross-sections are known, as well as the volume flow rate and the pressure in larger cross-section. What value of determined pressure is expected in relation to the pressure in the larger cross-section? 2. Order ascending: (1) the instantaneous filtration rate at the beginning of the filtration; (2) the instantaneous filtration rate at the end of the filtration; (3) average rate of the total filtration process; (4) filtration rate at the half of the total filtration time; (5) efficiency of the total filtration (when additional operation time is $_d$). The total volume of the filtrate is V_{filtr}, the resistance of filter medium can be neglected. 3. What is the ratio of the filtration rate at the same time for two processes under the constant pressure, if characterized by the filtration constant $K_2=2\cdot K_1$? What is the ratio of washing times for these processes, when the volume of washing liquid is the same? The resistance of filter medium can be neglected, i.e. $r_{tk}=0$. 4. Draw a graph log p = f(log u) for two fluidization processes in which solid particles are the same size but differing in density, i.e. $_1 >_2$: 5. Draw (a) an operating line for a counter-current absorption processes and (b) an operating line for co-current absorption process with the same absorption degree and the same concentration in the inlet stream of solvent. Determine the excess solvent used for both absorption processes based on the data in the graph. 6. Two single-stage extractions of feeds with different contents of the extracted component were carried out. The composition of extract phase is the same for both processes. Compare the mass of pure solvent used in these extraction. Justify your answer using (i) triangular coordinate systems and (ii) rectangular coordinate systems. 7. Draw a change of temperature along the co-current heat exchanger when a saturated steam is used as a heating medium. Discuss a) when the steam consumption for heating is the smallest; b) how the diagram of temperature changes along the heat-exchanger will change when the fluid of lower specific heat and of the same mass flow rate will be heated in this apparatus.
Work placement	Not applicable