



Subject card

Subject name and code	Process engineering, PG_00057796						
Field of study	Green Technologies						
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		English		
Semester of study	5		ECTS credits		9.0		
Learning profile	general academic profile		Assessment form		exam		
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 hab. inż. Patrycja Makoś-Chelstowska				
	Teachers		dr hab. inż. Patrycja Makoś-Chelstowska dr inż. Piotr Rybarczyk				
Lesson types	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						
	eNauczanie source addresses: Moodle ID: 7904 2026/27 Process engineering https://enauczanie.pg.edu.pl/2025/course/view.php?id=7904						
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		20.0		100.0	225
Subject objectives	The primary objective of the Process Engineering course is to provide students with a comprehensive understanding of the fundamental principles of fluid mechanics, heat transfer, and mass transfer operations. The course aims to develop practical analytical skills for designing, calculating, and optimizing key unit operations, including fluid transport, filtration, sedimentation, thermal exchangers, absorption, extraction, and drying. Ultimately, it prepares students to evaluate and implement efficient, sustainable process technologies within the framework of modern green technology solutions.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[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	critically evaluates their own knowledge in process engineering, recognize personal limitations when solving complex engineering problems, effectively prioritize tasks, and acknowledge the necessity for lifelong learning and professional expert consultation.	[SK1] Assessment of group work skills [SK2] Assessment of progress of work [SK3] Assessment of ability to organize work [SK4] Assessment of communication skills, including language correctness [SK5] Assessment of ability to solve problems that arise in practice
	[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	is able to apply analytical methods and fundamental principles of physics and mathematics to dimension, analyze, and evaluate selected process engineering operations and apparatuses (including fluid flow, solid-fluid separation, heat transfer, and mass transfer), as well as to interpret experimental/process data and assess existing technical solutions.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [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	knows and understands the theoretical fundamentals of process engineering, as well as the working principles and design features of chemical equipment used in fluid transport, mechanical separation, heat transfer, and mass transfer, and is able to relate these operations to the principles of sustainable and green technologies.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects

Subject contents	Course content – lecture		
	- Pressure units and their conversion. Fluid statics. Density of gases and liquids. Fluid viscosity. Bernoulli equation. Discharge of liquid from a tank. - Velocity profiles for laminar and turbulent flow. Darcy-Weisbach equation. Local resistance (minor losses). Leva equation. - Power required for pumping. Types of valves. Types of pumps. Drawing and reading process and chemical apparatus schematics. - Single-stage filtration at constant pressure (calculation of filtration constants, filtration time, and washing time). - Two-stage filtration. Types of filters. - Free settling of particles. Dust-settling chambers. Sedimentation. Settling tanks (settlers). Fluidization. - Heat transfer: Conduction, natural and forced convection. Overall heat transfer. Heat exchangers. - Absorption equilibrium. Counter-current absorption (mass balance, operating line, minimum and actual solvent flow rate). - Number of overall gas/liquid transfer units (NTU). Number of theoretical plates, theoretical and real plate efficiency. Absorption with recirculation. - Co-current absorption. Battery of absorption columns. Types of absorbers. - Extraction equilibrium. Minimum and maximum amount of solvent. Single-stage extraction (mass balance, balance of extracted substance). Multistage co-current extraction (mass balance, number of theoretical stages). Multistage counter-current extraction (mass balance, theoretical stages of extraction). Theoretical stages, efficiency of real stages. Types of extractors (extraction equipment).		
	Course content – laboratory		
	- Filtration (press filter or rotary drum filter) - Heat exchanger - Scaling of an orifice - Absorption - Fluidization		
	Course content – project		
	- Introduction. Pressure units and their conversion, density of gases and liquids, fluid viscosity, mass/volumetric flow rates, and average flow velocity. - Bernoulli equation and its application in fluid energy balances. - Darcy-Weisbach equation, local resistance, and power required for pumping. - Leva's equation. - Single-stage filtration at constant pressure covering filtration constants, filtration time, and filtrate volume. - Single-stage filtration parameters (filtration and washing rates, washing time, efficiency), discussion of design task 1 (rotary vacuum filter), sedimentation, free settling, and hydraulic classification. - Dust-settling chambers. - Heat flow fundamentals including heat conduction and natural convection. - Heat flow covering forced convection and overall heat transfer. - Heat exchangers and discussion of design task 2 (thermal insulation of hot apparatus). - Absorption fundamentals including concentrations, counter-current mass balance, operating line, and minimum/actual solvent rates. - Multistage co-current extraction. - Absorption continuation focusing on the number of overall gas/liquid transfer units (NTU). - Extraction equilibrium in the Gibbs triangle, including the rule of straight line, lever-arm principle, solvent limits, single-stage extraction, and yield.		
Prerequisites and co-requisites	Students enrolling in the course are expected to possess a foundational knowledge of higher mathematics and general physics. Additionally, students must demonstrate proficiency in performing mathematical calculations, manipulating algebraic equations, and applying the SI unit system correctly.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture - written exam	60.0%	40.0%
	Laboratory - written entrance tests and laboratory reports	60.0%	30.0%
	Project – individual written mini-projects and a large group project	60.0%	30.0%
Recommended reading	Basic literature	- Perry's Chemical Engineers' Handbook •Handbook of Chemical Engineering Calculations, 4th ed. 2012 (McGraw Hill) - Basic Principles and Calculation in Chemical Engineering , 6th ed., D. M. Himmelblau (Prentice Hall PTR 1996) - Unit operations in chemical engineering, 7th ed., W. L. McCabe, J. C. Smith, P. Harriott (McGraw Hill Inc. 2005) - Biochemical engineering, S. Katoh, J.Horiuchi, F. Yoshida (Wiley 2015)	
	Supplementary literature	- Sinnott, R., & Towler, G. <i>Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design</i> (6th ed.). Butterworth-Heinemann. - Zarzycki, R. <i>Wymiana ciepła i ruch masy w inżynierii środowiska</i>. Wydawnictwo Naukowe PWN.	
	eResources addresses		
Example issues/ example questions/ tasks being completed	- What are the differences between laminar and turbulent flow, and how does the Reynolds number affect the velocity profile in a pipe? - Explain the concept of the operating line in counter-current gas absorption. What parameters determine the minimum solvent flow rate? - Discuss the mechanisms of heat transfer (conduction, natural, and forced convection) and define the overall heat transfer coefficient.		

Practical activities within the subject	Not applicable
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