



Subject card

Subject name and code	Process team project, PG_00060876						
Field of study	Projekt procesowy zespołowy						
Date of commencement of studies	October 2023		Academic year of realisation of subject		2025/2026		
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	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. Robert Aranowski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	0.0	45.0	0.0	45
	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	45		10.0		65.0	120
Subject objectives	The aim of the course is to develop the ability to design, analyze, and evaluate technological processes based on real engineering data and current design standards used in the chemical, energy, and environmental industries. The course builds competencies in team-based project work, including role distribution, task management, integration of results, and responsibility for jointly developing a complete process design.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_K03] is aware of the responsibility for his/her own work and is ready to follow the rules of teamwork and take responsibility for the tasks performed jointly	The student collaborates effectively within a project team, taking on appropriate roles, supporting other team members, and demonstrating responsibility for assigned tasks and for the team's final outcome.	[SK1] Ocena umiejętności pracy w grupie
	[K6_W06] has knowledge of information technology and computer-aided design, the use of databases in technological design	The student uses computer-aided design tools (AutoCAD, Inventor), applies process simulators (ChemCAD), and makes use of databases of physicochemical properties and technical information in the design process.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
	[K6_W05] has knowledge of chemical technology based on mineral or energy resources and modern energy sources, understands the concept of sustainable development, knows the principles of green chemistry and environmentally friendly process engineering, has knowledge of occupational safety in the chemical industry	The student demonstrates knowledge of modern and sustainable chemical technologies, including processes based on mineral or energy resources, identification of the environmental impact of installations, and the principles of occupational safety and hazard minimization in designed technological systems.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
	[K6_U11] individually plans and implements his/her own learning	The student independently plans and organizes project work, searches for necessary technical information, supplements knowledge gaps using literature and industry sources, and develops the computational and programming skills required to complete the project.	[SU5] Ocena umiejętności zaprezentowania wyników realizacji zadania
	[K6_U04] performs basic design calculations of selected processes and unit operations, is able to calculate and select the basic apparatus of chemical industry in a process line	The student performs mass and energy balances, selects operating parameters for unit operations, and carries out design calculations for selected process equipment (columns, heat exchangers, reactors), using computational tools (Scilab/Matlab) and simulation tools (ChemCAD).	[SU1] Ocena realizacji zadania
Subject contents	Course content – project 1. Introduction to the project and division into teams. Discussion of the project scope, documentation requirements, project structure, and principles of teamwork. Selection of project topics. 2. Development of the preliminary technological concept. Defining the fundamentals of the process, functional description, and selection of the main unit operations. 3. Process block diagram. ** Identification of input/output streams. Creating the diagram in AutoCAD. 4. Process and unit operation parameters. Selection of technological parameters and preliminary calculation data. 5. Description of the technological process. Detailed description of the process sequence and interrelations between equipment and streams (ChemCAD). 6. Process Flow Diagram (PFD). Drawing the PFD. 7. Material balance. Mass balance calculations on an hourly and daily basis. Modeling process variants in ChemCAD and verifying calculations in Scilab/Matlab. 8. Energy balance. Determination of heating/cooling demand and analysis of energy losses. Use of ChemCAD thermal modules and calculation sheets. 9. Selection of construction materials and corrosion protection. Analysis of process media properties and selection of equipment materials. 10. Equipment list and operating schedule. Creating equipment lists and determining key equipment parameters. 11. Production control, workforce requirements, and occupational safety. Identification of control parameters and placement of measurement and control points. 12. Environmental impact assessment. Identification of emissions, waste, and wastewater based on ChemCAD balances. Modeling emission reduction and environmental mitigation measures. 13. Preparation of preliminary economic justification. CAPEX and OPEX estimation, economic evaluation of process options. 14. Development of industry-specific guidelines. Civil engineering, mechanical engineering, electrical engineering, automation and control. 15. Project presentations and final consultations. Team presentations.		

Prerequisites and co-requisites	Required Knowledge			
	The student should have:			
	1. a solid understanding of the fundamentals of chemical engineering, including mass and energy balances, heat and mass transfer, reaction kinetics, and the basics of hydraulics, 2. knowledge of unit operations such as absorption, distillation, chemical reactors, filtration, heat exchange, membrane separation, etc., 3. familiarity with the fundamentals of process design, including identification of process streams and operating parameters, 4. basic knowledge of occupational safety, environmental protection, and the principles of operating industrial installations.			
	Required Skills			
	The student should be capable of:			
	1. performing process calculations (e.g., equilibrium, kinetics, specific heat, balances) based on established engineering equations and correlations, 2. basic use of computational software such as: 3. Scilab/Matlab for numerical calculations, performing balances, and matrix operations, 4. ChemCAD (or another process simulator), at minimum understanding the interface and the basics of building simple simulations.			
	Technical Competencies			
	The student should:			
	1. have basic knowledge of technical drawing, 2. be able to prepare simple diagrams (conceptual and technological), preferably using AutoCAD or another CAD drafting tool, 3. distinguish between basic components of process installations (pumps, heat exchangers, columns, pipelines, valves), 4. understand the fundamentals of process automation and control (controlled variables, measurement points, control loops).			
	Soft Skills			
	The student should demonstrate:			
	1. the ability to work in a project team, 2. the ability to plan work and independently search for process data, 3. the ability to prepare technical reports and project presentations.			
	Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
		Assessment of activity and teamwork	60.0%	20.0%
		Project presentation	60.0%	20.0%
Assessment of the team project		60.0%	60.0%	
Recommended reading	Basic literature	1. L. Synoradzki, J. Wisiański, Projektowanie Procesów Technologicznych, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2019. 2. L. Synoradzki, J. Wisiański (praca zbiorowa), Projektowanie procesów technologicznych. Bezpieczeństwo procesów chemicznych, Oficyna Wydawnicza Politechniki Warszawskiej, 2012. 3. J. Głowiński, Przykłady i zadania do przedmiotu Podstawy technologii chemicznej, Politechnika Wrocławska, Wrocław 1991. 4. S. Kucharski, J. Głowiński, Podstawy obliczeń projektowych w technologii chemicznej, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000. 5. Myers Alan L., Obliczenia komputerowe w inżynierii chemicznej, Warszawa : Wydaw. Naukowo-Techniczne, 1979.		

	Supplementary literature	1. W. M. Lewandowski, R. Aranowski, Technologie ochrony środowiska w przemyśle i energetyce, Wydawnictwo Naukowe PWN, Warszawa, 2016. 2. Stelecki, L. Gradań, Podstawowe procesy przemysłu chemicznego, WNT, Warszawa 1985. 3. N.G. Anderson, Practical Process Research and Development, Academic Press, San Diego, California, USA 2000. 4. P.W. Atkins, Chemia fizyczna, PWN, Warszawa 2001. 5. Grzywa, Edward Jan, Technologia podstawowych syntez organicznych. T. 1, Surowce do syntez, Warszawa : Wydaw. Nauk.-Techn., 1995. 6. Pikoń Jerzy, Podstawy konstrukcji aparatury chemicznej. Cz. 1, Tworzywa konstrukcyjne, Warszawa: Państw. Wydaw. Nauk., 1979. 7. Myers Alan L., Obliczenia komputerowe w inżynierii chemicznej, Warszawa : Wydaw. Naukowo-Techniczne, 1979. 8. Pavlov, Konstantin Feofanovič, Przykłady i zadania z zakresu aparatury i inżynierii chemicznej. Tł.z j. ros, Warszawa : Państw. Wydaw. Tech., 1964. 9. Pikoń Jerzy, Aparatura chemiczna, Gliwice : Politechnika Śląska, 1971. 10. Szarawara Józef, Podstawy inżynierii reaktorów chemicznych, Warszawa : Nauk.-Techn., 1980.
	eResources addresses	Supplementary https://www.scilab.org/tutorials - Tutorials on how to use Scilab http://ChemCADProcessSimulationTutorials-YouTube - Examples of using ChemCAD software in process simulation https://esupport.aspentech.com - Aspen offers free courses (for universities and registered users → Register → "Training" tab → Aspen Plus for Beginners): https://www.youtube.com/user/LearnChemE - Aspen Plus Video Tutorials (YouTube) - Featured Channels https://www.youtube.com/results?search_query=aspen+plus+tutorial - Aspen Plus Video Tutorials (YouTube) - Featured Channels
Example issues/ example questions/ tasks being completed	Project Problem Description The goal of the project is to develop a complete carbon dioxide absorption unit for flue gas treatment using an aqueous monoethanolamine (MEA) solution. The task of the project team is to design a process enabling at least 85% CO₂ removal efficiency from a process gas stream with a typical composition for fossil-fuel combustion (1015% CO₂, 46% O₂, remainder N₂). The project includes preparing the technological concept, performing process calculations, selecting equipment, and conducting safety, environmental, and economic analyses of the installation. In the first stage, a conceptual process flow diagram must be developed and fully described, including CO₂ absorption in the contactor column and solvent regeneration in the desorption column. As part of the process design, students must determine the MEA concentration, select operating parameters (temperatures, pressures, flow rates), and prepare mass and energy balances based on process simulations performed in ChemCAD, supplemented with engineering calculations in Scilab/Matlab. Next, the student should prepare the technological Process Flow Diagram (PFD) and a simplified Piping and Instrumentation Diagram (P&ID), created in AutoCAD, including the main equipment, process streams, basic control instruments, and measurement points. In the further part of the project, selecting and sizing the equipment is required, including the absorption column, desorption column, heat exchangers, pumps, and storage tanks. A 3D model of one selected piece of equipment must also be created in Inventor to illustrate its design and assembly principles. The project must include an analysis of construction materials and corrosion protection methods, an assessment of operational safety, and identification of hazards related to high temperatures, steam, chemical substances, and pressurized systems. The student must also prepare an environmental impact assessment, including emissions after treatment, spent solvent management, and proposed measures to reduce the installations environmental impact. The final element of the project is preparing a preliminary economic justification, including an estimate of capital expenditures (CAPEX), operating costs (OPEX), utility consumption, and a basic profitability assessment (e.g., payback period or NPV). The project should conclude with the preparation of complete project documentation and its presentation, in which the team justifies the adopted technical, construction, and operational solutions.	
Practical activities within the subject	Not applicable	

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