GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Process team project, PG_00060876		
Field of study	Chemical Technology		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
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

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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_W06] Has knowledge in the field of management, entrepreneurship, intellectual property protection and the basics of humanities and social sciences, and also knows specialized chemical nomenclature	Student knows the basic principles of intellectual property protection and is able to apply them to technological solutions and project documentation.	[SW3] Assessment of knowledge contained in written work and projects
[K6_K03] Understands the need for continuous learning and knows the opportunities to improve professional, personal and social competences, and is able to think and act in an entrepreneurial manner.	Student is able to work effectively in a project team by assuming various roles and responsibilities, while developing communication and organizational skills.	[SK1] Assessment of group work skills
[K6_W05] Has knowledge of electrical engineering, automation and computer science, including the operation of measurement and control systems	Student has knowledge that enables the conceptual integration of automation and control elements into a process design, in accordance with technological requirements.	[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.	Student is able to identify potential corrosion hazards and take them into account when selecting materials and design solutions for a process installation.	[SU1] Assessment of task fulfilment

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%
Assessment of the team project	60.0%	60.0%
Project presentation	60.0%	20.0%

Recommended reading

Basic literature

1. L. Synoradzki, J. Wisialski, Projektowanie Procesów Technologicznych, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2019.
2. L. Synoradzki, J. Wisialski (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. Gradaoń, 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

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 activites within the subject

Not applicable

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