GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	DESIGN OF TECHNOLOGICAL PROCESSES, PG_00064398		
Field of study	Chemistry		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
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	5	ECTS credits	3.0
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	15.0	0.0	0.0	15.0	0.0	30

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 6828 Projektowanie procesów technologicznych, Chemia, 2027/28-01
https://enauczanie.pg.edu.pl/2025/course/view.php?id=6828

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	30	5.0	40.0	75

Subject objectives

The aim of the course is to introduce students to systematic process design in the chemical industry and to develop their ability to formulate a process concept leading from specified raw materials to a desired product. Students become familiar with the successive stages of process design, including searching for and critically evaluating scientific and patent information, identifying possible chemical synthesis routes, assessing their feasibility in terms of thermodynamics, stoichiometry, kinetics, catalysis and selectivity, and selecting appropriate product separation and purification methods. The course also introduces the fundamental principles of process documentation, material and energy balances. As part of the project, students apply the acquired knowledge to develop and justify a concept for a selected technological process and present it in the form of a conceptual process flow diagram.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_K03] is aware of the importance of caring for the quality and diligence of the tasks performed, being responsible for their consequences	is aware of the importance of correctly preparing project documentation while maintaining the necessary precision, consistency, and documentation standards, as well as the responsibility for the accuracy of the assumptions made and the proposed technical solutions.	[SK2] Assessment of progress of work
	[K6_U07] is able to undertake accurate and precise analytical measurements, to synthesise simple and large-molecular chemical compounds, to purify and analyse their composition and to determine their structure using classical and instrumental methods	is able to use experimental, analytical and literature data concerning substance properties and chemical reactions to develop and evaluate a technological process concept.	[SU1] Assessment of task fulfilment
	[K6_U05] designs and performs experiments to confirm a hypothesis, recognises the wider, often non-technical context of the phenomena analysed	is able to analyse alternative synthesis routes and process solutions, evaluating them on the basis of scientific and technical data as well as thermodynamic, kinetic, technological, environmental, safety and economic criteria, and subsequently selects and justifies a process concept.	[SU1] Assessment of task fulfilment
	[K6_W01] applies his/her knowledge of selected branches of mathematics and physics to analyse, interpret and solve problems and to describe physical, chemical phenomena and technological processes	has the knowledge of mathematics, physics, and chemistry necessary to analyze and assess technological processes, in particular to perform stoichiometric calculations and material and energy balances, and to evaluate the thermodynamic and kinetic conditions of chemical transformations.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents

Course content – lecture

Introduction to technological process design, including the nature of process design, stages of the design cycle and formulation of design assumptions. Scientific, technical and patent information sources used in process design, information retrieval methods and fundamental aspects of industrial property protection, including novelty, inventive step and freedom to operate. The influence of patent protection on the selection of technological routes for product manufacture.

Principles and structure of process design documentation. Use of laboratory procedures, experimental data and literature information to formulate process assumptions. Development of the chemical process concept, including the selection of reactions and synthesis routes, separation and purification methods, and the mode of process operation, particularly the choice between batch and continuous processing. Assessment of chemical transformations in terms of stoichiometry, thermodynamics, kinetics, catalysis, selectivity and basic economic considerations.

Fundamentals of assessing the environmental impact of process installations, identification of wastewater, solid waste and off-gas sources, and methods for their reduction, utilization or treatment. Principles of preparing process and engineering diagrams, including symbols, standards and conventions, stream numbering and division of the process into technological sections.

Principles for preparing and presenting material and energy balances and the use of Sankey diagrams to represent mass and energy flows. Fundamentals of construction material selection and corrosion protection. Process safety, occupational health and safety, and fire protection.

Fundamentals of selecting main and auxiliary process equipment and preparing equipment operating schedules for batch processes. Fundamentals of developing a process control concept and selecting measurement and actuator devices. Introduction to the economic assessment of process designs.

Course content – project

Development of a conceptual design for a selected technological process leading to the manufacture of a specified chemical product. Definition of the project objective and scope and formulation of the fundamental design assumptions. Review of scientific and technical literature and patent information to identify known production methods, possible synthesis routes and limitations resulting from industrial property protection.

Analysis and comparison of the identified synthesis routes with respect to reaction stoichiometry and thermodynamics and preliminary assessment of their chemical feasibility. Analysis of available information concerning reaction kinetics, catalysts, conversion, yield and selectivity. Development of criteria for comparing alternative routes and application of a decision matrix to select the preferred synthesis route.

Development of a concept for product separation and purification and recycling of unreacted raw materials, as well as a preliminary concept for the management of by-products, wastewater, solid waste and off-gases. Selection of the final chemical process concept and justification of the adopted solutions. Preparation of a conceptual process flow diagram showing the main unit operations and equipment, flows of raw materials and products, recycle streams and waste streams. Preparation of project documentation and presentation and defence of the developed process concept.

Prerequisites and co-requisites

Students should have fundamental knowledge of general, inorganic, organic and physical chemistry, particularly in the areas of chemical reaction stoichiometry, phase and chemical equilibria, thermodynamics and reaction kinetics. Basic knowledge of material and energy balances and unit operations used in chemical technology is also required. Students should be able to use scientific and technical literature, perform basic engineering calculations, and present and interpret data in the form of tables, graphs and diagrams.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Evaluation of project documentation	60.0%	40.0%
Activity (mini quizzes)	60.0%	15.0%
Project presentation	60.0%	15.0%
Colloquium - lecture	60.0%	30.0%

Recommended reading

Basic literature

1. Marchildon, K., & Mody, D. (2018). *Practical process design for chemical engineers*. Wiley.
2. Smith, R. (2016). *Chemical process design and integration* (2nd ed.). Wiley.
3. Turton, R., Bailie, R. C., Whiting, W. B., Shaeiwitz, J. A., & Bhattacharyya, D. (2018). *Analysis, synthesis, and design of chemical processes* (5th ed.). Pearson.

	Supplementary literature	1. Green, D. W., & Southard, M. Z. (Eds.). (2019). Perrys chemical engineers handbook (9th ed.). McGraw-Hill Education. 2. Seider, W. D., Seader, J. D., Lewin, D. R., Widagdo, S., Gani, R., & Ng, M. K. (2017). Product and process design principles: Synthesis, analysis and evaluation (5th ed.). Wiley.
	eResources addresses	
Example issues/ example questions/ tasks being completed	**Conceptual Design of a Technological Process for Ethyl Acetate Production** The aim of the project is to develop and justify a technological concept for the industrial production of ethyl acetate. Based on a review of scientific and technical literature and patent information, possible production methods and synthesis routes should be identified and subsequently compared. The analysis should consider the availability and properties of raw materials, reaction stoichiometry and thermodynamics, operating conditions, kinetics, catalyst requirements, conversion, yield and selectivity, as well as the feasibility of product separation and purification. The main technological, environmental and safety constraints should be identified, and potential limitations resulting from industrial property protection should be considered. The identified alternatives should be compared using defined evaluation criteria and a decision matrix. For the selected synthesis route, a process concept should be developed, including the proposed mode of operation, principal separation and purification operations, possible recycling of raw materials, and management of by-products and waste streams. The final project should include a justification for the selected chemical process concept and a conceptual process flow diagram showing the principal unit operations, equipment and material streams.	
Practical activites within the subject	Not applicable	

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