GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Methodology of simulation and optimization of technological processes , PG_00035159		
Field of study	Engineering and Technologies of Energy Carriers		
Date of commencement of studies	February 2022	Academic year of realisation of subject	2022/2023
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to practical vocational preparation
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	practical profile	Assessment form	assessment
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Robert Aranowski	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	0.0	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	3.0	27.0	75

Subject objectives

The aim of the course is to present (theoretically and practically) modern simulation tools and solving process problems. Understanding the capabilities of dynamic models in a training application (OTS)

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_W13	Student is able to choose the right mathematical model to simulate the work of industrial devices and apparatus	[SW3] Assessment of knowledge contained in written work and projects
K7_U05	Student is able to use teamwork skills when formulating models of technological processes	[SU1] Assessment of task fulfilment
K7_U06	Student is able to use the costing estimating module during process simulations using PetroSIM software	[SU4] Assessment of ability to use methods and tools
K7_W10	Student is able to choose the appropriate mathematical model of calculations of chemical equilibrium and thermal effects of the process	[SW3] Assessment of knowledge contained in written work and projects
K7_W04	Student is able to simulate an industrial processes using PetroSIM software	[SW3] Assessment of knowledge contained in written work and projects

Subject contents

Concepts of empirical, analog, physical and mathematical model; Introduction to the real problems of design, modeling, optimization and scaling up of processes. Estimation of measuring errors and calculation of additive errors, factor design and curtailed sampling plans for modeling of physical and chemical processes. Utilization of statistical methods to control industrial processes. Mathematical description of chemical processes, types of mathematical models, the balance equations for apparatus models, the equations of mass and energy balances. Simulation models: black box models, deterministic models, software for simulation and design processes. Processes simulation rules: objects with lumped and distributed parameters in a steady and transient state. Approximation and prediction properties of the substance: density, viscosity, the critical parameters, the liquid proper volume, gas proper volume, volatility of gases and liquids, phase equilibrium (equation of Margules van Laar and Wilson). Chemical equilibrium, calculating the concentrations at steady state. A database of physicochemical properties of pure substances, properties of mixtures and phase equilibrium. Modern simulation methods, solving process problems, simulation of mass flows, full simulation and optimization of steady-state processes. Simulation of chemical processes using the PetroSIM software. Principles operation of process simulators based on dynamic simulation. The building of process simulator (OTS)

Prerequisites and co-requisites	Knowledge of unit processes, including the distillation and rectification, mass and energy transfer. Knowledge of the basic equipment and apparatuses used in the chemical industry. Knowledge about basic physico-chemical parameters of matter.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test	60.0%	50.0%
Project	60.0%	50.0%

Recommended reading

Basic literature	1. Leigh J. R., Modelling and simulation, London, Peter Peregrinus, 1983. 2. William Luyben, Process Modeling, Simulation and Control for Chemical Engineers, McGraw-Hill Chemical Engineering Series, 1996.
Supplementary literature	1. Octave Levenspiel, Chemical reaction Engineering, John Wiley & Sons, 1999.
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Diethyl ether is produced by catalytic dehydration of ethanol at 450-500 K. The raw material is fed to the reactor after pre-evaporation and the gas phase is heated up to 450 K. The reactor consists of a bundle of tubes filled by a catalyst. It is assumed that the consumption of the catalyst is small amount and its presence in the stream leaving the reactor can be omitted. The product stream coming out of the reactor is pre-cooled to 345 K and separated in a destilation column where the ether is abtained as a top product. The residue (bottom product) from the first column, containing ethanol and water, is separated in the second column and the top product (containing 92% of ethanol), is recycled to the reactor. For the production of ether, rectified ethyl alcohol with 95% by weight is used. The ethanol conversion at a single pass through the reactor is 0.90, and the entire process takes place under atmospheric pressure. Draw up a diagram of the ether production and calculate a material and energy balance of the process for the production of 1500 kg/hr of the ether. Use the CHEMCAD/PetroSIM software to draw up the material and energy balance of the process.
Work placement	Not applicable