Zał. nr 5 do ZW 78/2023

Attachment no. 4. to the Program of Studies

FACULTY of Chemistry

SUBJECT CARD

Name of subject in Polish Aparaty inżynierii chemicznej

Name of subject in English Chemical Processes Equipment

Main field of study (if applicable): Chemical Engineering and Technology

Specialization (if applicable): Advanced Chemical Engineering

Profile: academic / ~~practical~~*

Level and form of studies: ~~1st/~~ 2nd level~~, uniform magister studies~~*, full-time ~~/ part-time~~*

Kind of subject: obligatory ~~/ optional / university-wide~~*

Subject code W03CET-SM2001W, W03CET-SM2001P

Group of courses ~~YES /~~ NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			60	
Number of hours of total student workload (CNPS)	50			100	
Form of crediting (Examination / crediting with grade)	E			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	2			4	
including number of ECTS points for practical classes (P)				4	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,6			2,4	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of physics and general chemistry.
2. Understanding of energy, power, heat and mass transfer concepts.
3. Understanding of thermodynamics rules.
4. Basics of calculus.
5. Knowledge of the international system of units (SI).
6. Knowledge of the principles of technical drawing.
7. The ability to use AutoCAD.

SUBJECT OBJECTIVES

C1 Acquaintance student with technological process, apparatus and equipment being part of chemical installation.

C2. Gaining by the student the basic knowledge on the work of the process equipment applied for material transportation, heat and mass transfer.

C4. Acquaintance students with the apparatus for measurement, and manual and automatic control, applied in chemical installations.

C5. Presentation of methods for searching for, processing and analyzing calculation results.

C6. Familiarization of the student with the principles of creating and reading technological schemes.

C7. The ability to use computer-aided design in the creation and modification of technological schemes.

C8. Introduction to modern software for the simulation and design of chemical plants.

C9. Acquainting with the construction of unit operations and chemical plant models.
C10. Teaching how to perform simulation and design calculations.
C11. Teaching the search and processing of obtained calculation results.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 – knows what the technological process, production installation, and what role the different apparatus play in the process installation.
PEU_W02 – knows basic equipment applied in the chemical industry installation.
PEU_W03 – knows fundamentals of design of unit operations and selection of the apparatus and constructional materials.
PEU_W04 – knows the rules of the measurement and control equipment selection as well as safety rules applied for chemical installations.

relating to skills:

PEU_U01– Can create and read a technological scheme.
PEU_U02 – Can use the methods of computer aided design in the creation and modification of technological schemes.
PEU_U03 – Can perform sensitivity analyses, optimisation calculations and set design specifications.
PEU_U04 – Can build a mathematical process model and perform simulation calculations using professional software
PEU_U05 – Can perform design calculations of selected unit operations
PEU_U06 – Can determine the physicochemical properties of substances and phase equilibria

relating to social competences:

PEU_K01 – can discuss the problems of the work conditions and equipment selection for chemical technology installation.
PEU_K02 – can work in a team.
PEU_K03 – can appreciate the quality of an experimental result ;
PEU_K04 – can evaluate critically the veracity of statistical analysis of any data.

PROGRAMME CONTENT

Lecture		**Number of hours**
Lec1	Technological process. Unit processes and unit operations. Scheme of a technological system. Rules of the equipment selection. Equipment for raw materials, semi-products, products, and wastes storage.	2
Lec2	Means of transport for the materials. Friction losses during the process of fluids transportation in the pipelines.	2
Lec3	Equipment for grinding, mixing, sedimentation, filtration and spinning.	2
Lec4	Equipment for heat transfer.	2
Lec5	Equipment for evaporation and liquid solutions concentration.	2
Lec6	Equipment for absorption and distillation.	2
Lec8	Equipment for extraction and adsorption.	2
Lec9	Exam.	1
	Total hours	15

Project	**Number of hours**

Industrial plant engineering and design		
Pr1	Introduction into the environment of AutoCAD Plant 3D. Familiarization with the user interface. Creating and managing a project in AutoCAD Plant 3D. Files management. Familiarization with the different work spaces.	2
Pr2	Working with the specification editor and part catalog - AutoCAD Plant 3D Spec Editor.	2
Pr3-4	P&ID drawing - creating a design and a technological drawing in 2D. Inserting process equipment into the installation diagram. Pipelines. Adding fittings. Adding descriptions to the technological drawing.	4
Pr5-6	Industrial plant 3D Project - modeling of steel constructions	4
Pr7	Industrial plant 3D Project - addition and configuration of process equipment	2
Pr8-9	Industrial plant 3D Project - connecting equipment with pipelines, addition of fittings.	4
Pr10-11	Documentation - creating and printing 2D documentation in AutoCAD Plant 3D.	4
Pr12-13	Design data management and reporting in AutoCAD Plant 3D. Data exchange with other applications - AutoCAD, Inventor Professional, Excel.	4
Pr14	Preparation of final projects	2
Pr15	Presentation and submission of the final project documentation in AutoCAD Plant 3D.	2
	Sum of hours	**30**

Project		**Number of hours**
Calculation and optimisation of unit processes		
Pr1	Presentation of the principles for completing the course. Discussion of the use of simulation software in chemical and process engineering. Introduction to the Aspen Plus interface.	2
Pr2	Principles of proper selection of physical property models.	2
Pr3-4	Sensitivity analysis and design specifications.	4
Pr5-6	Analysis and estimation of physicochemical properties of pure components and mixtures.	4
Pr7	Test 1	2
Pr8	Basics of hydraulic calculations. Calculation of pressure drops in pipelines. Simulation of the operation of media displacement devices. The cavitation issue.	2
Pr9	Determination of properties of solid materials, including granular materials. Simulation of the separation of solid materials.	2
Pr10	Simulation of equilibrium distillation and rectification.	2
Pr11	Simulation of the extraction process.	2
Pr12	Types of chemical reactors. Simulation of the operation of chemical reactors.	2

Pr13	Elements of heat exchanger calculations - an introduction to Aspen Exchanger Design and Rating.	2
Pr14	Optimisation of the chemical installation	2
Pr15	Test 2	2
	Sum of hours	**30**

TEACHING TOOLS USED

N1. Lecture.
N2. Multimedia presentation.
N3. AspenPlus simulation and design software
N4. Aspen Exchanger Design and Rating program for simulation and design of heat exchangers
N5. Aspen Properties program for calculating physicochemical properties of fluids and phase equilibria
N6. Microsoft Excel program for calculation of basic unit processes
N7. Individual work in simulation software.
N8. Using Autodesk Plant 3D software, AutoCAD, Autodesk Inventor.
N9. Preparing the project.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P=F1 (Lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Exam
P=F2 (Project)	PEU_U01 PEU_U02 PEU_K01- PEU_K04	Project preparation
P=F3 (Project)	PEU_U03 PEU_U04 PEU_U05 PEU_U06 PEU_K01- PEU_K04	Test 1 Test 2 Project preparation

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Green D.W. i Perry R.H., *Perry's Chemical Engineers' Handbook*. McGraw-Hill, 2008.
[2] Couper J., Penney W., Fair J. i Walas S.M., *Chemical engineering equipment – selection and design*. 3rd edition. Elsevier, 2012.
[3] Tickoo S., AutoCAD Plant 3D 2023 for Designers, ADCIM Technologies; 7th edition, 2022.
[4] Toghraei M., Piping and Instrumentation Diagram Development, Wiley-Aiche, 2019.
[5] R. Shefflan, Teach Yourself the Basics of AspenPlus, John Wiley & Sons, 2011.

SECONDARY LITERATURE:

[6] Tutorial Books, Introduction to AutoCAD Plant 3D 2019, Tutorial Books, 2018.

[7] R. Smith, *Chemical Process Design and Integration*, Wiley 2005.
[8] K. Al-Malah, Aspen Plus® Chemical Engineering Applications, Wiley, Hoboken, 2017.
[9] J. Haydary, Chemical Process Design and Simulation: Aspen Plus and Aspen Hysys Applications, Wiley, 2019.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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