FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in English: Separation of heterogeneous systems
Main field of study (if applicable): Chemical and Process engineering
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st level, full-time
Kind of subject: obligatory
Subject code: ICC013007
Group of courses: YES

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	30	
Number of hours of total student workload (CNPS)	90		60	60	
Form of crediting	Exam		crediting with grade	crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	3		2	2	
including number of ECTS points for practical (P) classes			2	2	
including number of ECTS points for direct teacher-student contact (BU) classes	1,3		1,4	1,5	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of principles of chemical engineering.

SUBJECT OBJECTIVES

C1 To provide student's knowledge about the principles of unit pressure processes used in chemical engineering
C2 To provide student student's knowledge about various kinds of heterogenic systems
C3 To provide student's knowledge about construction of apparatuses used in separation processes
C4 To provide student's knowledge about basic equations which describe rate of separation in various separation apparatuses
C5 To provide student's knowledge about choosing the right separation process according to the defined application
C^ To provide student's knowledge about using filtration, centrifugal, flotation and ultra-filtration separators

SUBJECT LEARNING OUTCOMES

related to knowledge:

PEK_W01 student knows principles of construction and idea of working of equipment elements in separation processes of heterogenic systems both in laboratory and industrial scale
PEK_W02 student knows calculations methods for description of separation process efficiency
PEK_W03 student knows parameters which can increase and decrease separation process efficiency and methods for limitation of filtrate flow downturn
PEK_W04 student can list a number of separation applications and describe them with details
PEK_W05 student knows the principles of rescaling of processes

related to skills:

PEK_U01 student can apply and use proper methods for separation of chosen heterogenic systems
PEK_U02 student is able to calculate constants from the equations related to the rate of specific separation

process and indicate the parameters that can increase process efficiency
PEK_U03 student can plan and organize both his individual and team work

related to social competences:
PEK_K01 student understands the significance of obtained knowledge both theoretical and practical and is ready to use his skills in practice
PEK_K02 student can work in a team in the conducting the experiments and their results analysis (with computer)

PROGRAMME CONTENT

Lectures		**Number of hours**
Lec 1	Types of heterogenic systems. Types of separation method.	2
Lec 2	Types of suspensions. Drawling – process idea, applications.	2
Lec 3	Sedimentation – batch and continuous	2
Lec 4	Mechanical sludge purification.	2
Lec 5	Coagulation and flocculation – principles of the process. Sedimentation applications.	2
Lec 6	Flotation – process principles and applications.	2
Lec 7	Filtration – types of compartments, methods of production of driving force	2
Lec 8	Filtration – devices and applications	2
Lec 9	Introduction to the pressure membrane processes. Applications of micro- and ultra-filtration	2
Lec 10	Sedimentation and filtration – centrifuges. Process applications. Hydrocyclones – principles of working and applications	2
Lec 11	Methods of creating the heterogenic systems – immobilisation of catalysts; crystallisation; mutual crystallisation	2
Lec 12	Emulsion systems – characteristics, methods of creations and destruction	2
Lec 13	Purification of air from solid pollutions	2
Lec 14	Mixing in order to obtain the pseudo-homogenic systems – types of stirrers, power of mixing.	2
Lec 15	Revising the material with students short questions	2
	Sum	30
Laboratory		**Number of hours**
La 1	Separation of suspension in low and high pressure with use of filtration	6
La 2	Flotation	6
La 3	Filtration with disk filtration and filtration press	6
La 4	Separation of emulsion in centrifugal device	6
La 5	Ultrafiltration	6
	Sum	30
Project		**Number of hours**
P 1	Choice of project subject, discussion	2
P 2	Presentation of whole process in which designed device is going to be – problem description	2
P 3	Presentation of concept of solution	2

P 4	Analysis of mechanism of separation process	2
P 5	Presentation of ideal solution with assumption that all problems were solved	2
P 6	Presentation of initial process parameters	2
P 7	Determination of key parameters, bottlenecks	2
P 8	Process balance, naming the flows, process scale definition	2
P 9	Analysis of resource need, efficiency of production	2
P 10	Graphic designed device presentation	2
P 11	Mechanical durability, materials, weight of device	2
P 12	Measurements locations, their type and placing	2
P 13	Economical analysis	2
P 14,15	Presentation of final project – discussion on the strong and weak points of chosen solution	4
	Sum	30

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Laboratory
N3. Multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1(lecture)	PEK_W01 - PEK_W04	Writing exam for 10 points
F2-F6 (laboratory)	PEK_U01 – PEK_U03	Points for each experiment – test + laboratory report (max. 5 points each)
F7 (project)	PEK_W01-05; PEK_U01-03	Presentation and preparation of final project

P (lecture) = F1= 10 pkt.
9.5 - 10 pkt. + very good
9.0 – 9.4 pkt. very good
8.0 – 8.9 pkt. + good
7.0 – 7.9 pkt. good
6.0 – 6.9 pkt. + adequate
5.0 - 5.9 pkt. Adequate

P (laboratory) = (F2+F3+F4+F5+F6)
P = 3.0 if points sum is 60-67,9%
3.5 if points sum is 68-75,9%
4.0 if points sum is 76-83,9%
4.5 if points sum is 84-89,9%
5.0 if points sum is 90-98%
5.5 if points sum is >98%

P(project) = F7=10 pkt.
9.5 - 10 pkt. + very good
9.0 – 9.4 pkt. very good
8.0 – 8.9 pkt. + good
7.0 – 7.9 pkt. good
6.0 – 6.9 pkt. + adequate
5.0 - 5.9 pkt. adequate

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Koch R., Noworyta A., Procesy mechaniczne w inżynierii chemicznej, WNT Wa-wa 1995
[2] Pikoń J., Aparatura chemiczna, PWN, Warszawa 1978
[3] Lewicki P., Inżyniera procesowa i aparatura przemysłu spożywczego, Wydawnictwo Naukowe PWN, 2017

SECONDARY LITERATURE:

[1] Seider W. D., Lewin D. R., Seader J. D., Widagdo S., Gani R., Ng K- Ming. ,Product and Process Design Principles: Synthesis, Analysis and Evaluation, 4th Edition, Wiley, 2016
[2] Selecki A., Gawroński R., Podstawy projektowania wybranych procesów rozdzielania mieszanin, WNT 1992

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

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