

FACULTY of CHEMISTRY

SUBJECT CARD**Name of subject in Polish** Procesy membranowe**Name of subject in English** Membrane processes**Main field of study (if applicable):** Chemical Engineering and Technology**Specialization (if applicable):** Advanced Chemical Engineering**Profile:** academic**Level and form of studies:** 2nd level**Kind of subject:** obligatory**Subject code** W03CET-SM2002W, W03CET-SM2002L, W03CET-SM2002S**Group of courses** NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		45		15
Number of hours of total student workload (CNPS)	50		75		25
Form of crediting (Examination / crediting with grade)	crediting with grade		crediting with grade		crediting with grade
For group of courses mark (X) final course					
Number of ECTS points	2		3		1
including number of ECTS points for practical classes (P)			3		1
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,6		1,8		0,6

1w+3l +1s (2+3+1 ECTS).**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Fundamentals of organic chemistry
2. Fundamentals of chemical engineering

SUBJECT OBJECTIVES

- C1 To become familiar with the construction and characteristics of membranes.
 C2 To become familiar with the types of membrane processes and their application.
 C3 To become familiar with measurement methods during a membrane process.

SUBJECT EDUCATIONAL EFFECTS

In terms of knowledge:

PEU_W01 The student knows the chemical and physical structure of membranes.

PEU_W02 The student knows what membrane processes are and when to use them.

From the scope of skills:

PEU_U01 The student is able to carry out a process on a membrane plant and determine its membrane performance and selectivity.

PEU_U02 The student knows how to prepare documentation for a membrane process.
 PEU_U03 The student is able to find examples of applications of membrane processes in the literature and prepare a presentation on them.

In terms of social competence:

PEU_K01 The student is able to engage in discussion and critically evaluate his/her own work and that of others in the course.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Introduction to clean technologies.	2
Lec 2	Circular economy. Application of membrane processes in waste fractionation.	2
Lec 3	Membrane construction and structure of membrane modules.	2
Lec 4	Pressurised membrane processes.	3
Lec 5	Diffusion membrane processes.	3
Lec 6	Membrane electro-processes. Liquid membranes.	2
Lec 7	Written course credit	1
	Total hours	15

Laboratory		Number of hours
La1	Microfiltration of bacterial and yeast cells.	5
La2	Ultrafiltration process.	5
La3	Protein hydrolysis coupled to nanofiltration.	15
La4	Pervaporation of beer.	5
La5	Dialysis.	5
La6	Membrane extraction.	5
La7	Reverse osmosis	5
	Total hours	45

Seminar		Number of hours
Se1	Introduction to the class - application of membrane processes.	1

Se2	Micro- and ultrafiltration processes.	2
Se3	Nanofiltration and reverse osmosis.	2
Se4	Membrane extraction and distillation.	2
Se5	Pervaporation and dialysis.	2
Se6	Vapour and gas separation.	2
Se7	Liquid membranes. Membrane fabrication.	2
Se8	Electrodialysis, electrodifffusion.	2
	Total hours	15

TEACHING TOOLS USED	
N1. Lecture with multimedia presentation N2. Laboratory. N3. Students presentations. N4. Consultations.	

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 (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Credit test
F1 (laboratory) P=F1	PEU_U01 PEU_U02 PEU_U03 PEU_K01 PEU_K02	Laboratory exercise reports (arithmetic mean)
P (seminar)	PEU_U04	presentation
3.0 if $3.00 \leq P < 3.25$ 3.5 if $3.25 \leq P < 3.75$ 4.0 if $3.75 \leq P < 4.25$ 4.5 if $4.25 \leq P < 4.75$ 5.0 if $4.75 \leq P$		
PRIMARY AND SECONDARY LITERATURE		

PRIMARY LITERATURE:**LITERATURA PODSTAWOWA:**

- [1] Membrane processes, Robert Rautenbach, 1989.
- [2] Membrane Modification: Technology and Applications – Nidal Hilal, Mohammed Khayet, Chris Wright, 2012.
- [3]

SECONDARY LITERATURE:

- [4] Multimedia presentation materials.

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

Anna Trusek, anna.trusek@pwr.edu.pl