



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Separation of Mixtures

### Course

Field of study

Pharmaceutical Engineering

Area of study (specialization)

-

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

4/7

Profile of study

general academic

Course offered in

polish

Requirements

compulsory

### Number of hours

Lecture

15

Laboratory classes

0

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

### Number of credit points

1

### Lecturers

Responsible for the course/lecturer:

prof. dr hab. inż. Krystyna Prochaska

Responsible for the course/lecturer:

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Faculty of Chemical Technology

Institute of Chemical Technology and  
Engineering

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### Prerequisites

Elementary knowledge in the field of general, inorganic, organic and physical chemistry as well as familiarity with the equipment of the pharmaceutical industry; awareness of main environmental hazards resulting from industrial activity.

### Course objective

The aim of the lecture is to gain theoretical knowledge in the field of membrane separation techniques used in the pharmaceutical industry, i.e. water preparation processes, pharmaceutical separation and wastewater treatment from the pharmaceutical industry.



### Course-related learning outcomes

#### Knowledge

K\_W8 knows the principles of environmental protection related to pharmaceutical technology and waste management; has necessary knowledge on hazards related to implementation of chemical and pharmaceutical processes

K\_W15 has detailed knowledge in separation processes and treatment of raw materials and products used in pharmaceutical, cosmetic and chemical industry

K\_W18 has basic knowledge in terms of construction of equipment and installations in pharmaceutical industry and in related industries

#### Skills

K\_U15 is able to identify basic unit processes and operations of pharmaceutical engineering and formulate their specifications

K\_U16 is able to select the proper approach and equipment to solve elementary and complex engineering problems related to pharmaceutical engineering; is able to analyze and evaluate the functioning of basic equipment of pharmaceutical industry

#### Social competences

K\_K2 is ready to: take the individual decisions and lead the team, to critically evaluate his or her own activity and activity of the team, to take the responsibility for the effects of those activities; he or she is able to collaborate and work in group, inspire and integrate the people in his or her professional work environment

K\_K3 is aware of importance of understanding the non-technical aspects and consequences of engineering activity including its impact on the natural environment and the responsibility related to the decisions made in this area; he or she identifies properly the problems and take the right choices related to the professional activity according to the professional ethical rules and care about the output and traditions related to the profession

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written/oral exam graded on the basis of a points system (0-100 points)

3	50,1 -70,0 points
4	70,1 -90,0 points
5	90,1 -100 points

### Programme content

The lectures cover the following topics:

1. Basic concepts and definitions regarding membrane separation techniques



2. Modeling of mass transport in porous and non-porous membranes
3. Characteristics and modeling of concentration polarization processes and membrane fouling
4. Pressure-driven membrane separation techniques (the theoretical basis of processes: MF, UF, NF, RO and examples of applications in water preparation, pharmaceutical separation and wastewater processing in the pharmaceutical industry)
5. Concentration-driven membrane separation processes (process characteristics: GS, DD, PV and examples of applications, especially in medicine and pharmaceutical industry)
6. Current-driven membrane techniques (classical ED and bipolar ED)
7. Membrane distillation (process characteristics and application examples)
8. Membrane reactors, construction characteristics and principle of operation, examples of applications in the processes of obtaining pharmaceuticals.
9. Multistage membrane separation systems used in medicine and pharmacy.

### Teaching methods

Lecture: multimedia presentation illustrated with examples shown on a blackboard

### Bibliography

#### Basic

1. M. Bodzek, J. Bohdziewicz, K. Konieczny, Techniki membranowe w ochronie środowiska, Wydawnictwo Politechniki Śląskiej, Gliwice, 1997.
2. K. Prochaska (Red.) Membranowe techniki separacji, Skrypt, Wydawnictwo Politechniki Poznańskiej, Poznań, 2013
3. M. Bodzek, K. Konieczny, Usuwanie zanieczyszczeń nieorganicznych ze środowiska wodnego metodami membranowymi, Wydawnictwo Seidel-Przywecki, Warszawa 2011.
4. J. Rautenbach, Procesy membranowe, WNT, Warszawa 1996
5. E. Biernacka, T. Suchecka, Techniki membranowe w ochronie środowiska, Wyd. SGGW, Warszawa 2004

#### Additional

1. S. Judd, C. Judd (Red.) The MBR Book. Principles and applications of membrane bioreactors for water and wastewater treatment, 2nd ed., Elsevier, 2011
2. Z. Zhang, W. Zhang, E. Lichtfouse, Membranes for Environmental Applications, Springer, 2020
3. K. Scott, Handbook of industrial membranes, Elsevier Advanced Technology, 1998



4. P.W. Atkins, Chemia fizyczna, Wyd. Nauk. PWN, Warszawa 2003.

**Breakdown of average student's workload**

	Hours	ECTS
Total workload	30	1,0
Classes requiring direct contact with the teacher	15	0,5
Student's own work (literature studies, preparation for tests/exam) <sup>1</sup>	15	0,5

<sup>1</sup> delete or add other activities as appropriate