COURSE DESCRIPTION CARD - SYLLABUS

Course name
Separation of mixtures [S1IFar2>ORM2]

Course

Field of study
Pharmaceutical Engineering

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

prof. dr hab. inż. Krystyna Prochaska
krystyna.prochaska@put.poznan.pl

Lecturers

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:
1. Student knows the principles of environmental protection related to pharmceutrical technology and waste management; has necessary knowledge on hazards related to implentation of chemical and pharmaceutical processes. [K_W8]
2. Student has detailed knowledge in sepration processes and treatment of raw materials and products used in pharmaceutical, cometic and chemical industry. [K_W15]

3. Student has basic knowledge in terms of construcion of equipment and installations in pharmaceutical industry and in related industries.[K_W18]

Skills:
1. Student is able to identify basic unit processes and operations of pharmaceutical engineering and formulate their specifications. [K_U15]
2. Student is able to select the proper approach and equipment tosolve elemenatry and complex engineering problems related to pharmaceutical engineering; is able to analyze and evaluate the functioning of basic equipment of pharmaceutical industry. [K_U16]

Social competences:
1. Student is ready to: take the individual desicions and lead the team, to critically evaluathe 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 prefessional work environment. [K_K2]
2. Student is aware of importance of understandint 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. [K_K3]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written/oral test (stationary or online on the e-courses platform) including 3-5 open questions, assessed on a point scale (51% -60% (3.0), 61% -70% (3.5); 71% -80% (4.0), 81% -90% (4.5), 91% -100% (5.0)

Programme content

The program covers the following topics:
1. Basic concepts and definitions regarding membrane separation techniques.
2. Mass transport in membranes.
3. Concentration polarization processes and membrane fouling.
4. Pressure-driven membrane separation techniques.
5. Concentration-driven membrane separation processes.
6. Current-driven membrane techniques.
7. Membrane distillation.
8. Membrane reactors.
9. Multistage membrane separation systems used in medicine and pharmacy.

Course topics

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 aplications of membrane bioreators 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	1,00
Classes requiring direct contact with the teacher	15	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	15	0,50