COURSE DESCRIPTION CARD - SYLLABUS

Course name
Membrane techniques of separation [S2IChiP1>MTS]

Course

Field of study
Chemical and Process Engineering

Year/Semester
1/2

Area of study (specialization)
Bioprocesses and Biomaterials Engineering

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

basic knowledge of general chemistry, physical chemistry, thermodynamics, organic chemical technology and chemical engineering (curriculum of the first degree studies), as well as broadly understood environmental protection, including types of pollution; ability to obtain information from indicated sources.

Course objective

Obtaining theoretical knowledge in the field of membrane separation methods. Theoretical foundations of individual membrane separation techniques and their areas of application in various industries, wastewater treatment, and water preparation processes. Membrane modules and principles of construction of membrane installations. Hybrid systems in air and wastewater treatment processes, as well as the production of organic bio-compounds

Course-related learning outcomes

Knowledge:
k_w03 - has expanded and in-depth knowledge in chemistry and other related areas of science, allowing to formulate and solve complex tasks related to chemical engineering
k_w07 - has knowledge of the latest chemical and material technologies, knows current trends in the

development of chemical industrial processes
k_w09 - has knowledge of environmental protection problems related to the implementation of industrial chemical processes

Skills:
k_u09 - can analyze and solve problems related to chemical technology and process engineering, using theoretical, analytical, simulation and experimental methods
k_u10 - can verify concepts of engineering solutions about the state of knowledge in chemical and process engineering as well as chemical technology
k_u13 - can critically analyze industrial processes and introduce modifications and improvements in this area, using the acquired knowledge, including knowledge about the latest achievements of science and technology
k_u19 - can design and evaluate the course of an experiment and process, analyze the possibilities of integrating unit processes due to the raw material, by-product or final product

Social competences:
k_k01 - understands the need for lifelong learning;
k_k02 - is aware of the importance and understands the non-technical aspects and effects of engineering activities, including its impact on the environment and the associated responsibility for decisions
k_k03 - can interact and work in a group

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Written/oral exam (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)
assessment of student activity during laboratory classes, assessment of knowledge necessary for the implementation of individual laboratory classes, passing the laboratory exercises based on the report on the developed results; assessment of team work and ability to solve scientific problems

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. Concentration polarization and membrane fouling processes
4. Pressure-driven membrane separation techniques (theoretical foundations of processes: MF, UF, NF, RO and areas of industrial applications)
5. Concentration-driven membrane separation processes (process characteristics: GS, DD, PV and examples of applications)
6. Current-driven membrane techniques (classical ED and bipolar ED)
7. Membrane distillation (process characteristics and application examples)
8. Liquid membranes (characteristics and areas of application)
9. Membrane reactors (construction, catalytic membranes, examples of applications)
10. Hybrydowe i wielostopniowe układy separacyjne bazujące na technikach membranowych stosowane w procesach oczyszczania powietrza, przerobu ścieków oraz pozyskiwania bio-związków organicznych

Course topics

Issues related to membrane methods of separation of mixtures.

Teaching methods

Lecture: multimedia presentation illustrated with examples shown on a blackboard.
Laboratory classes - practical exercises.

Bibliography

Basic
1. M. Bodzek, J. Bohdziewicz, K. Konieczny, Techniki membranowe w ochronie środowiska, Wydawnictwo Politechniki Śląskiej, Gliwice, 1997.
2. M. Bodzek, K. Konieczny, Wykorzystanie procesów membranowych w uzdatnianiu wody, Oficyna Wydawnicza Projprzem-EKO, Bydgoszcz 2005.
3. J. Rautenbach, Procesy membranowe, WNT, Warszawa 1996.
4. skrypt pod red. K. Prochaska, Techniki separacji membranowej, Wydawnictwo PP, Poznań 2012.
Additional
1. P. W. Atkins, Chemia fizyczna, Wyd. Nauk. PWN, Warszawa 2003.
2. M. Bodzek, K. Konieczny, Usuwanie zanieczyszczeń nieorganicznych ze środowiska wodnego metodami membranowymi, Wydawnictwo Seidel-Przywecki, Warszawa 2011.
3. Z. J. Grzywna, A. Strzelewicz, Opis matematyczny i analiza transportu masy gazów i par przez membrany polimerowe lite: czyste składniki i mieszaniny gazów, Membrany teoria i praktyka, z. III, Wykłady monograficzne i specjalistyczne, Toruń 2009, 5–29.
4. J. Ceynowa, Membrany selektywne i procesy membranowe, Membrany teoria i praktyka,z. II, Wykłady monograficzne i specjalistyczne, Toruń 2009, 7–29.
5. M.Mulder, Basic Principles of Membrane Technology, Kliwer Academic Publishers, Dfordrecht 1992
6. E. Biernacka, T. Suchecka, Techniki membranowe w ochronie środowiska, Wyd. SGGW, Warszawa 2004.
7. H. Strathmann, Ion-Exchange Membrane Separation Processes, Elsevier, New York 2004.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50