COURSE DESCRIPTION CARD - SYLLABUS

Course name
Separation technologies [S2TCh2-PTiB>TS]

Course

Field of study
Chemical Technology

Year/Semester
1/2

Area of study (specialization)
Technological Processes and Bioprocesses

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
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

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_W3 - has knowledge of complex chemical processes, including the appropriate selection of materials, raw materials, methods, techniques, apparatus and equipment for carrying out chemical processes and characterizing the products obtained

K_W8 has extended knowledge of environmental issues related to the implementation of chemical processes
K_W11 has an established and expanded knowledge of the selected specialty

Skills:
K_U1 has the ability to obtain and critically evaluate information from literature, databases and other sources, and formulate opinions and reports on this basis
K_U11 is able to properly verify the concepts of engineering solutions in relation to the state of knowledge in technology and chemical engineering
K_U12 has the ability to adapt knowledge of chemistry and related fields to solve problems in the field of chemical technology and planning new industrial processes
K_U15 is able to critically analyze industrial chemical processes and introduce modifications and improvements in this area, using the acquired knowledge, including knowledge about the latest achievements of science and technology
K_U17 can critically assess the practical usefulness of using new developments in chemical technology

Social competences:
K_K1 is aware of the need for lifelong learning and professional development
K_K3 professionally recognizes problems and makes the right choices related to the exercise of the profession, in accordance with the principles of professional ethics
K_K7 understands the need to provide the public with information on the current state and directions of development of chemical technology, on the principles of use and handling of chemical products, about the risks of obtaining raw materials, chemical production and distribution

Methods for verifying learning outcomes and assessment criteria

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)

Programme content

Issues concerning membrane separation methods including areas of application in various industries, wastewater treatment, and water preparation processes.

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 (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 assumptions, catalytic membranes, examples of applications)
10. Hybrid and multi-stage separation systems based on membrane techniques

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. 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.nternational Publishing AG, 2017.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	34	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	16	0,50