COURSE DESCRIPTION CARD - SYLLABUS

Course name
Membrane Separation Techniques

Course

Field of study
Environmental Protection Technologies

Year/Semester
III/6

Area of study (specialization)
-

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
30

Other (e.g. online)

Tutorials
0

Projects/seminars
0

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

basic knowledge of general chemistry, physical chemistry, thermodynamics, organic chemicaltechnology and chemical engineering, as well as broadly understood environmental protection, including types of pollution.

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 (laboratory classes)

Course-related learning outcomes

Knowledge

K_W05 - knows the rules of environmental protection related to chemical production and waste management

K_W11 - has the knowledge to describe the basic development trends related to environmental protection technologies

K_W12 - knows the methods, techniques, tools and materials used to solve simple engineering tasks related to environmental technologies

Skills

K_U01 - obtains information from literature, databases and other sources related to chemical sciences, integrates them, interprets and draws conclusions and formulates opinions

K_U08 - uses the terminology and nomenclature in force in the field of environmental protection technology correctly

K_U16 - performs analysis, verifies existing technical solutions in the field of environmental protection technology

K_U18 - can assess the suitability and choose tools and methods to solve the problem in the field of environmental protection technology

Social competences

K_K01 - understands the need for further training and raising their professional and personal competences

K_K02 - is aware of the importance and understanding of non-technical aspects and effects of engineering activities, including its impact on the environment and the associated responsibility for decisions made

K_K07 - understands the need to provide the public with information about the beneficial and unfavorable aspects of activities related to the production and use of chemical compounds; is able to convey such information in a commonly understandable way

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

assessment of student's activity in laboratory classes, assessment of teamwork and the 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. 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. Membrane reactors (construction assumptions, catalytic membranes, examples of applications)

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.nternational Publishing AG, 2017.

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,0
Classes requiring direct contact with the teacher	45	1,5
Student's own work (literature studies, preparation for tests/exam and laboratories classes)[1]	15	0,5

[1] delete or add other activities as appropriate