(faculty stamp)

COURSE DESCRIPTION

1) Course title: Membrane Technology	**2) Kod przedmiotu:**
3) Validity of course description: 2018/2019	
4) Level of studies: BSc programme	
5) Mode of studies: intramural studies	
6) Field of study: INDUSTRIAL AND ENGEENERING CHEMISTRY (RCH)	
7) Profile of studies: general academic	
8) Programme: -	
9) Semester: VI	
10) Faculty teaching the course: FACULTY OF CHEMISTRY	
11) Course instructor: prof. dr hab. inż. Marian Turek	
12) Course classification: common	
13) Course status: compulsory	
14) Language of instruction: English	
15) Pre-requisite qualifications: Physical chemistry, Chemical engineering	
16) Course objectives: To survey basic principles and engineering aspects of modern separation techniques using membranes which find a host of applications in the beverage, food, pharmaceutical, chemical and biochemical industries and also find use in drug delivery devices, and energy conversion systems; classification of synthetic polymeric membranes and use of inorganic membranes as alternative	
17) Description of learning outcomes:	

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Understanding of fundamental principles, driving force and transport mechanisms in pressure driven, electromembrane and diffusive membrane processes	Test	Lecture	**K_W07 ++** **K_W14 +** **K_W18 +**
2.	To have basic knowledge about concentration polarization and fouling as well as methods of mitigation of them by proper design of membrane module and mode of operation	Test	Lecture	**K_W12 ++** **K_W14 +**
3.	To have knowledge about membranes classification: porous, non-porous, symmetric, asymmetric, ion-exchange and basic types of membrane modules: tubular, spirally wound, filtration press	Test	Lecture	**K_W03 +** **K_W14 +**
4.	To be able to calculate membrane process efficiency parameters like current efficiency, retention coefficient	Test	Lecture/Lab	**K_U07 ++** **K_W18 ++**
5.	To be able to choose a proper membrane method to solve a given technological problem based on separation potential of different membrane techniques	Test	Lecture/Lab	**K_W18 ++** **K_U21 ++**
6.	To understand the importance of constant studying and increasing professional skills as well as following professional ethics.	Test	Lecture/Lab	**K_K01 +**

18) Teaching modes and hours

Lecture	Class	Laboratory	Project	Seminar
30	0	15	0	0

Syllabus description:

Lecture: Function and industrial applications of membrane. Types of membranes available. Basic membrane properties and their characterization. Basic commercial membrane systems. Fundamentals of membrane-based processes. Principles and operation of

reverse osmosis (RO) systems. Principles and operation of microfiltration (MF) systems. Principles and operation of ultrafiltration (UF) systems. Principles and operation of nanofiltration (NF) systems. Principles and operation of gas separation (GS) systems. Principles and operation of pervaporation (PV) systems. Electromembrane processes. Principles and operation of electrodialysis (ED) system and other electromembrane processes. Developments in membrane technology. Developments in membrane systems. Principles and operations of membrane reactor (MR) and membrane contractor (MC). The basic principle of artificial kidney, artificial lung, and controlled drug release. Hybrid membrane and integrated systems advantages and examples of their applications. Preparation of synthetic polymeric and inorganic membranes.

Laboratory: Electrodialysis, Nanofiltration, Reverse osmosis, Investigation of membrane properties.

19) Examination: no

20) Primary sources:

1. R. W. Baker, Membrane Technology and Applications, John Wiley and Sons, 2004.
2. M. Mulder, Basic Principles of Membrane Technology, Kluwer Academic Publishers, 1996.

21) Secondary sources:

1. A. Narębska (red.): Membrany i membranowe techniki rozdziału. Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń 1997.
2. R. Rautenbach: Procesy membranowe. WNT, Warszawa 1996.

22) Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1.	Lecture	30/30
2.	Classes	0/0
3.	Laboratory	15/7
4.	Project	0/0
5.	BA/ MA Seminar	0/0
6.	Other	10/8
	Total number of hours	55/45

23. Total hours:	100
24. Number of ECTS credits:	3
25. Number of ECTS credits allocated for contact hours:	2
26. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):	1

27. Comments:

In order to pass the course, student must meet the following conditions:

- Attendance at all of the laboratory classes confirmed by written report,
- Attendance at the tests held throughout the semester (at least half of them),
- Achieving average test grade of at least 3.0

Approved:

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(date, Instructor's signature) *(date , the Director of the Faculty Unit signature)*