Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Chemical Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Area(s) of study	nauki techniczne		
Educational profile	general academic		
Module			
Course unit	**Chemical Reactor Engineering**		
Code	ChEn_1A_S_C11		
Field of specialisation			
Administering faculty	Institute of Chemical Engineering and Environmental Protection Processes		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Code*	*Semester*	*Hours*	*ECTS*	*Weight*	*Credit*
lecture	W	4	30	2,5	0,40	credits
laboratory course	L	4	15	1,0	0,30	credits
project course	P	4	30	1,5	0,30	credits

Leading teacher	Pianko-Oprych Paulina (Paulina.Pianko@zut.edu.pl)
Other teachers	Konopacki Maciej (Maciej.Konopacki@zut.edu.pl), Lubkowski Krzysztof (Krzysztof.Lubkowski@zut.edu.pl), Murasiewicz Halina (Halina.Murasiewicz@zut.edu.pl), Pianko-Oprych Paulina (Paulina.Pianko@zut.edu.pl), Rakoczy Rafał

Prerequisites	
W-1	Mathematics
W-2	Physics
W-3	Thermodynamics

Module/course unit objectives	
C-1	Fundamentals of chemical reaction engineering. Rate laws, kinetics, and mechanisms of homogeneous and heterogeneous reactions. Analysis of rate data, multiple reactions, heat effects, bioreactors. Design of industrial reactors. Chemical Reaction Engineering (CRE) is the core subject in the specialties of Chemical Engineering and Technology. It mainly involves the study on industrial-scale chemical processes including chemical reaction rate, materials balance, and influences of macro-engineering factors. The objectives are to achieve the optimization control on industrial reaction process, and reactor development, design and scaling-up. Chemical reaction engineering is also concerned with the exploitation of chemical reactions on a commercial scale. Its tasks are to make students grasp the knowledge as follows: (i) thermodynamics, (ii) kinetics, (iii) transport processes, (iv) types of reactors, (v) operation mode and contacting, (vi) modeling and optimization, and (vii) control.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Stoichiometry of elementary and complex reactions. Mole balances, conversions and desig equation. Kinetic rate laws. Single chemical reaction and multiple reactions (reversible, consecutive, parallel).Types of reactor: Batch Reactor, RB, Continuous Stirred-Tank Reactor, CSTR, continuous Plug-Flow Reactor, PFR. Multiple reactions, yield and selectivity. Analysis of reactor performance data. (PPO,	30
T-L-1	Practical study of batch reactor	8
T-L-2	Practical study of continous reactor	7
T-P-1	Calculation of chosen type of reactor - part 1 (HM).	15
T-P-2	Calculation of bioreactor - part 2 (MK).	15

Student workload - forms of activity		*Number of hours*
A-W-1	Classroom participation	30
A-W-2	Preparation to the lecture.	30
A-W-3	Independent study of the subject matter of the classes	15
A-L-1	Participation in laboratories.	15
A-L-2	Preparation for labs.	15
A-P-1	Participation in project classes.	30
A-P-2	Independent execution of design calculations	15

Teaching methods / tools

Teaching methods / tools	
M-1	Preparation of a multimedia for of lecture presentation
M-2	Project method.
M-3	Demonstration of the chosen type of reactor.

Evaluation methods (F - progressive, P - final)		
S-1	P	Written final exam based on the lecture contents.
S-2	F	Project report - part 1.
S-3	F	Project report - part 2.
S-4	F	Active participation in laboratory classes.

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to the learning outcomes defined for the particular areas of education	Reference to learning outcomes leading to the degree of "inżynier"	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
ChEn_1A_C11_W01 Student is able to define fundamentals of chemical reactions. Student can analyze models of reactors and is able to explain the used chemical reactors construction and select an appropriate type of reactor for specific needs.	ChEn_1A_W04 ChEn_1A_W06 ChEn_1A_W10 ChEn_1A_W11 ChEn_1A_W14	P6S_WG_TA11	P6S_WG_IA11	C-1	T-W-1	M-1	S-1
Skills							
ChEn_1A_C11_U01 Student can propose and calculte chemical reaction kinetics. Student is able to perform calculations for chosen types of reactors: Batch Reactor, Continuous Stirred Tank Reactor, Plug Flow Reactor.	ChEn_1A_U01 ChEn_1A_U03 ChEn_1A_U05 ChEn_1A_U07 ChEn_1A_U08 ChEn_1A_U16	P6S_UO P6S_UU P6S_UW_TA11 P6S_UW_TA14	P6S_UW_IA11 P6S_UW_IA14	C-1	T-P-1 T-P-2	M-2	S-2 S-3
Other social / personal competences							
ChEn_1A_C11_K01 Student can present and defence the role of chosen chemical reactor design. Student can demonstrate ability to take responsibility and collaborate with others when working in a team during the labs.	ChEn_1A_K01 ChEn_1A_K03 ChEn_1A_K04 ChEn_1A_K05	P6S_KK P6S_KO P6S_KR		C-1	T-L-1 T-L-2	M-3	S-4

Required reading
1. Fogler, H. S., Elements of Chemical Reaction Engineering, Prentice-Hall PTR, 2006, 9780130473943, Upper Saddle River
2. Levenspiel O., Chemical Reaction Engineering, Wiley,, New York, 1999, 9780471254249
3. Steinfeld, J. I., J. S. Francisco, and W. L. Hase., Chemical Kinetics and Dynamics, Prentice Hall, 1999, 9780137371235

Supplementary reading
1. E. B. Nauman, Chemical Reactor Design, Optimization, and Scale-up, John Wiley and Sons, USA, 2008
2. L.M. Rose, Chemical Reactor Design in Practice, Elsevier Scientific Publishing Company, New York, 1981