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	**Introduction to Experimental Chemical Engineering**		
Code	ChEn_1A_S_C09a		
Field of specialisation			
Administering faculty	Institute of Chemical Engineering and Environmental Protection Processes		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives	4	*Elective group*	

Form of instruction	*Code*	*Semester*	*Hours*	*ECTS*	*Weight*	*Credit*
lecture	W	4	15	1,0	0,50	credits
laboratory course	L	4	45	3,0	0,50	credits

Leading teacher	Cudak Magdalena (Magdalena.Cudak@zut.edu.pl)
Other teachers	Aleksandrzak Tomasz (Tomasz.Aleksandrzak@zut.edu.pl), Cudak Magdalena (Magdalena.Cudak@zut.edu.pl), Karcz Joanna (Joanna.Karcz@zut.edu.pl), Kiełbus-Rąpała Anna (Anna.Kielbus-Rapala@zut.edu.pl), Major-Godlewska Marta (Marta.Major@zut.edu.pl), Moszyński Dariusz (Dariusz.Moszynski@zut.edu.pl), Szoplik Jolanta (Jolanta.Szoplik@zut.edu.pl), Witkiewicz Konrad (Konrad.Witkiewicz@zut.edu.pl)

Prerequisites

W-1	Introduction to Chemical Engineering

Module/course unit objectives

C-1	The course aims to give a general introduction to the experimental chemical engineering

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Inroduction to experimental chemical engineering. Measurements of density and viscosity of liquids; Rheological properties	2
T-W-2	Fluid flow measurements (Pressure-based meters: Orifice Plate, Pitot tube, Prandtl tube, Venturi meter; Variable-area flow meter: rotameter).	2
T-W-3	Measurement, calibration and computer acquisition of process parameters; measurement errors; measurement uncertainties	3
T-W-4	Mass transport process investigations. Conditions of conducting of the process in dispersed systems, methods for measuring mass transfer coefficients in gas-liquid and solid-liquid systems in an agitated vessels	2
T-W-5	Agitated vessel: mixing equipment; power consumption – experimental techniques, power characteristics; liquid homogenization; mixing time – experimental techniques, mixing time measurement; heat and mass transfer in agitated vessel: methods for measuring of heat and mass transfer coefficients; multiphase flow – equipment; various types of agitated vessels: construction of advantages and disadvantages, their application	3
T-W-6	Various types of reactors: construction of advantages and disadvantages, their application. Air-lif: mixing equipment; liquid homogenization; mixing time – experimental techniques, mixing time measurement; mass transfer – methods of mass transfer coefficient measurements	3
T-L-1	The rheological properties of the Non-Newtonian fluid	4
T-L-2	Fluidization	4
T-L-3	Measurement, calibration and computer acquisition of process parameters	3
T-L-4	Gas composition analysis using GC and MS	4
T-L-5	Mixing time in agitated vessel	4
T-L-6	Mass transfer process in mechanically agitated solid-liquid system	4
T-L-7	Process characteristics of the air-lift reactor	3
T-L-8	Fluid flow measurements	4
T-L-9	Heat transfer in an agitated vessel	4
T-L-10	Mass transfer in gas-liquid system in an agitated vessel	4
T-L-11	Production of gas-liquid system in an agitated vessel	4

Course content divided into various forms of instruction		*Number of hours*
T-L-12	Power consumption	3

Student workload - forms of activity		*Number of hours*
A-W-1	Obligatory attendance the lectures	15
A-W-2	Remembering, understanding and analyzing of the lectures content - repeating the lecture contents to pass	15
A-L-1	Obligatory attendance the laboratory works	45
A-L-2	Literature study on the topics of laboratory exercises	30
A-L-3	repetition of the problems analyzed in the laboratory	15

Teaching methods / tools	
M-1	lecture
M-2	laboratory exercises

Evaluation methods (F - progressive, P - final)		
S-1	P	lectures - written test
S-2	P	laboratory - report and test

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_C09a_W07 to give a general introduction to the experimental chemical engineering	ChEn_1A_W06 ChEn_1A_W07 ChEn_1A_W08 ChEn_1A_W11	P6S_WG_TA11		C-1	T-W-1 T-W-4 T-W-2 T-W-5 T-W-3 T-W-6	M-1	S-1
Skills							
ChEn_1A_C09a_U09 Student has ability to solve different practical problems on chemical engineering.	ChEn_1A_U01 ChEn_1A_U03 ChEn_1A_U05 ChEn_1A_U08 ChEn_1A_U09 ChEn_1A_U16	P6S_UO P6S_UU P6S_UW_TA11 P6S_UW_TA12 P6S_UW_TA14	P6S_UW_IA11 P6S_UW_IA12 P6S_UW_IA14	C-1	T-L-1 T-L-7 T-L-2 T-L-8 T-L-3 T-L-9 T-L-4 T-L-10 T-L-5 T-L-11 T-L-6 T-L-12	M-2	S-2
Other social / personal competences							
ChEn_1A_C09a_K01 Student understands the needs of continuous training and development in the field of chemical engineering	ChEn_1A_K01 ChEn_1A_K03 ChEn_1A_K04 ChEn_1A_K05	P6S_KK P6S_KO P6S_KR		C-1	T-W-3	M-1 M-2	S-1

Required reading

1. Denn M.M., Chemical Engineering. An introduction., Cambridge University Press, New York, 2012

2. Sinnott R.K., Harker J.H., Coulson & Richardson's, Chemical Engineering, Vol.6: Chemical Engineering Desing, Butterworth-Heinemann, Oxford, 2003

3. Incropera F.P., Lavine A.S., DeWitt D.P., Fundamentals of Heat and Mass Transfer, Willey, New Jersey, 2011

4. Coulson J.M., Richardson J.F., Backhurst J.R., Harker J.H.,, Coulson & Richardson’s Chemical Engineering, Vol. 1: Fluid Flow, Heat Transfer and Mass Transfer,, Butterworth-Heinemann, Oxford, 1999

5. Coulson J.M., Richardson J.F., Backhurst J.R., Harker J.H.,, Coulson & Richardson’s Chemical Engineering, Vol. 2: Particle Technology and Separation Processes, Butterworth-Heinemann, Oxford, 2002

6. Backhurst J.R., Harker J.H., Richardson J.F.,, Coulson & Richardson’s Chemical Engineering, Vol. 4: Solutions to the problems in Vol. 1, Butterworth-Heinemann, Oxford, 2001

7. Backhurst J.R., Harker J.H.,, Coulson & Richardson’s Chemical Engineering, Vol. 5: Solutions to the problems in Volumes 2 and 3, Butterworth-Heinemann, Oxford, 2002

Supplementary reading

1. Annaratone D, Engineering heat transfer, Spriger, 2009

2. Karwa R., Heat and mass transfer, Springer, 2016