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 Technology**		
Code	ChEn_1A_S_C09b		
Field of specialisation			
Administering faculty	Institute of Inorganic Chemical Technology and Environmental Engineering		
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	Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)
Other teachers	Bartkowiak Marcin (Marcin.Bartkowiak@zut.edu.pl), Moszyński Dariusz (Dariusz.Moszynski@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)

Prerequisites	
W-1	basics of chemistry
W-2	Advanced mathematics
W-3	basics of physics

Module/course unit objectives	
C-1	Getting knowledge about analytical methods applied in Chemical Technology

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Instrumental methods of chemical composition analysis. Selecting of a proper analytical methods. Theoretical basics of atomic spectroscopy. Inductively Coupled Plasma, ICP. Atomic absorption spectroscopy, AAS. Molecular spectra method. Infrared Spectroscopy, FTIR, UV-VIS Spectroscopy, Raman Spectroscopy RS. X-ray methods. X-Ray Fluorescence, XRF, X-Ray Microanalysis; GC and GC-MS in separation and analysis of post-reaction mixtures.	4
T-W-2	Chemical analysis of the surface of solid state. Physicochemical basics of Electro-spectroscopy methods. Methods: Electron Spectroscopy for Chemical Analysis, ESCA, including X-ray Photoelectron Spectroscopy, XPS, and Ultraviolet Photoemission Spectroscopy, UPS; Auger Electron Spectroscopy, AES, Electron Energy Loss Spectroscopy.	4
T-W-3	Adsorption/desorption methods and temperature programmed techniques. Thermogravimetry, TG, Temperature Programmed Desorption, TPD, Temperature Programmed Oxidation, TPO, Temperature Programmed Reduction, TPR, Temperature Programmed Surface Reaction, TPSR. Mass spectrometry.	3
T-W-4	Analysis of phase composition, structure and topography. X-Ray Diffraction, XRD, Reflection High Energy Electron Diffraction, RHEED, Low Energy Electron Diffraction, LEED. Mössbauer Spectroscopy. Scanning Electron Microscopy, SEM, and Transmission Electron Microscopy, TEM, Atomic Force Microscopy, AFM.	4
T-L-1	Reaction exhaust gases – MS analysis	5
T-L-2	Reactivation of catalyst for ammonia synthesis	5
T-L-3	Activation of heterogeneous catalyst based on cobalt compounds	5
T-L-4	XRD phase analysis catalysts	5
T-L-5	SEM analysis of catalysts	5
T-L-6	XRF analysis of catalysts	5
T-L-7	Deep oxidation methods in waste water treatment	5
T-L-8	GC and GC-MS methods as a methods for separation and analysis	5
T-L-9	FTIR analysis of the products	5

Student workload - forms of activity		*Number of hours*
A-W-1	Obligatory attendance the lactures	15
A-W-2	Repetition of the material	15

Student workload - forms of activity		*Number of hours*
A-L-1	Participation in laboratory classes	45
A-L-2	Data evaluation and preparation of raports	45

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory classes

Evaluation methods (F - progressive, P - final)		
S-1	P	Written exam

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_C09b_W01 Student knows theory required to design basic chemical technology process in laboratory scale.	ChEn_1A_W06 ChEn_1A_W07 ChEn_1A_W08 ChEn_1A_W11	P6S_WG_TA11		C-1	T-W-1 T-W-3 T-W-2	M-1	S-1
Skills							
ChEn_1A_C09b_U01 Student is able to mount basic laboratory scale instalation used in chemical technology and evaluate the obtained data with mother IT tools.	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-4 T-L-6 T-L-5	M-2	S-1
Other social / personal competences							
ChEn_1A_C09b_K01 Student is able to work in team in designing the chemical technology laboratory scale setups.	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-6 T-L-2 T-L-7 T-L-3 T-L-8 T-L-4 T-L-9 T-L-5	M-1 M-2	S-1

Required reading

1. John A. Dean, Analytical Chemistry Handbook, McGraw-Hill Companies, 2000

1. Peter R. Griffiths, James A. de Haseth., Fourier transform infrared spectrometry, John Wiley & Sons, Hoboken, 2007, 2nd

2. Helmut Günzler, Alex Williams, Handbook of Analytical Techniques, Wiley-VCH, 2001

4. Paul N. Cheremisinoff, Handbook of water and wastewater treatment technology, Marcel Dekker, New York, 1995

5. Andrzej T. Gierczycki, Łukasz Kurowski, Jan Thullie, Gas cleaning and wastewater treatment for industrial and engineering chemistry students, Wydawnictwo Politechniki Śląskiej, Gliwice, 2011

6. Georges Guiochon, Claude L. Guillemin, Quantitative gas chromatography for laboratory analyses and on-line process control, Elsevier, Amsterdam, 1988

7. Richard L. MacCreery, Raman spectroscopy for chemical analysis, Wiley-Interscience, New York, 2000