

FACULTY OF CHEMISTRY					
SUBJECT CARD					
Name of subject in English:	Fundamentals of analytical chemistry				
Main field of study (if applicable):	all Faculty of Chemistry				
Specialization (if applicable):					
Profile:	academic				
Level and form of studies:	1st level, full-time				
Kind of subject:	obligatory				
Subject code:					
Group of courses:	NO				
	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Exam		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BU) classes	0,65		1,4		
PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES					
1 Basic knowledge and abilities on general chemistry and inorganic chemistry					
SUBJECT OBJECTIVES					
C1 To provide students to be familiar with basic principles and procedures in analytical chemistry					
C2 To provide students to be familiar with knowledge on appropriate analytical procedures conducted for detection and determination of selected sample constituents					
C3 To provide student with ability to work with gravimetric and volumetric analysis					
SUBJECT LEARNING OUTCOMES					
related to knowledge:					
PEK_W01 Knows basic definitions and methods of analytical chemistry					
PEK_W02 Knows fundamentals of analytical approach for detection and determination of selected sample constituents					
PEK_W03 Knows methods of sampling and sample preparation procedures appropriate to various types of samples					
PEK_W04 Has knowledge of wet digestion in open and closed system, dry ashing in open and closed system, melting the analytical samples					
PEK_W05 Has elements of knowledge of separation techniques such as: precipitation, liquid-liquid extraction, solid-phase extraction and chromatographic methods					
PEK_W06 Knows theoretical fundamentals and applications of titrimetric and gravimetric methods of analysis					
PEK_W07 Has knowledge of statistical analysis of results					
related to skills:					
PEK_U01 Correctly carries out specific operations of classical chemical analysis (weighing, analytical precipitation, filtering precipitates, sampling, titrating)					

PEK_U02 Is capable of performing simple quantitative analysis using gravimetric or titrimetric methods of analysis as well as spectrometric method		
PEK_U03 Is able to describe a course of analysis with the use of chemical reactions		
PEK_U04 Is able to calculate results of executed analysis		
PROGRAMME CONTENT		
Lectures		Number of hours
Lec 1	The vocabulary of analytical chemistry: analytical chemistry, analysis, analytical method, analytical procedure, detection and detection limit, determination and limit of determination, matrix of a sample, interferent and interference, contamination and sources of contamination, preventing contamination, sample in analytical chemistry (primary, random, reduced, representative, test sample, analytical; basic classification of analytical methods	2
Lec 2	The sequence of analytical process; defining the problem and goal of the analysis; the method to be employed with respect to detection limit, limit of determination, specificity, selectivity, sensitivity, precision, accuracy, reproducibility	2
Lec 3	Sampling and sample preparation; the type of sample, hierarchy of sampling terms; error sources in chemical analysis, method of sampling solids, slurry, liquids, gases; ways of reducing of the sample	2
Lec 4	Preparing samples for analysis: conditioning, preservation, dissolution, wet digestion in open and closed system, radiant energy (UV, microwave) assisted decomposition; digestion of metals and alloys – chemical reactions, characterization of acids involved; dry ashing in open and closed system, melting the analytical samples	2
Lec 5	Partial and complete isolation of analytes; classification of separation technique; distribution coefficient and Nernst's distribution law; what is trace analysis; selective precipitation and coprecipitation (principle, examples); liquid-liquid extraction (principle, drawbacks and advantages, examples); solid-phase extraction (principle, drawbacks and advantages, examples); liquid chromatography	2
Lec 6	Titrimetric analysis: definition of some terms, typical procedure, classification of volumetric methods (according to the types of reaction, way of titration, the equivalence point detection), standard solution and standardization, primary standard, relative and absolute error of titration, acid-base titration, reduction-oxidation titration, complexometric titration, precipitation titration (principle, primary standard used, indicators, examples of determinations)	2
Lec 7	Gravimetric analysis: general principles, typical procedure, steps of precipitation process, types of precipitates in gravimetric analysis, processes accompanying precipitation of colloids (coagulations, peptization, surface adsorption), examples of application	2
Lec 8	Statistics for analytical chemistry: measures of statistical distribution, relative and absolute error, confidence interval	1
Total hours		15
Laboratory		Number of hours
Lab1	Safety and laboratory rules. Grading. Schedule. General procedures of good laboratory technique	2
Lab2- Lab3	Acid-base titration - standardization of an HCl solution and determination of NaOH	4
Lab 4- Lab5	Determination of Na ₂ CO ₃ and NaOH in a solution (acid-titration with a HCl solution)	4

Lab6- Lab7	Determination of Fe and Ni in a solution - gravimetric determination of Fe	4
Lab8- Lab9	Determination of Fe and Ni in a solution continuation – red-ox titration of Fe	4
Lab10- Lab11	Determination of Fe and Ni in a solution (cont.) - complexometric titration of Fe and Ni	4
Lab 12- Lab 13	Water chemical analysis - determination of hardness and Cl ⁻ ions	4
Lab 14- Lab 15	Water chemical analysis – determination of O ₂ and NH ₄ ⁺ ions	4
Total hours		30
TEACHING TOOLS USED		
N1 Informative lecture N2 Completing quantitative analysis N3 Report preparation N4 Office hours		
EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Learning outcomes number	Way of evaluating learning outcomes achievement
P1 (lecture)	PEK_W01-PEK_W07	Examination (grade)
F1	PEK_U01-PEK_U04	Grade on experimental work = arithmetic mean of grades achieved for lab reports prepared on conducted analyses and obtained results
F2	PEK_U02-PEK_U04	Grade on tests 1-4 (max. 12 points) F2 = 3,5 if 6,00-7,50 points 4,0 if 7,75-9,00 points 4,5 if 9,25-10,50 points 5,0 if 10,75-11,00 points 5,5 if 11,25-12,00 points
$P (\text{laboratorium}) = 2/3 \times F1 + 1/3 \times F2$		
PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE:</u>		
[1] A. Cygański, Chemiczne metody analizy ilościowej, wyd. 7, WNT, Warszawa, 2013		
[2] J. Minczewski, Z. Marczenko, Chemia analityczna t. 1 i 2, wyd. 9, PWN, Warszawa, 2019		
[3] T. Lipiec, Z.S. Szmal, Chemia analityczna z elementami analizy instrumentalnej, wyd.7, PZWL Warszawa, 1996		
[4] D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Podstawy chemii analitycznej t. 1 i 2 (przekład z j. ang.), PWN, Warszawa, 2006		
<u>SECONDARY LITERATURE:</u>		
[1] Ćwiczenia rachunkowe z chemii analitycznej, praca zbiorowa pod red. Z. Galusa, wyd. 10, PWN, Warszawa, 2019		
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)		
Prof. dr hab. inż. Paweł Pohl, pawel.pohl@pwr.edu.pl		