STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Analytical and instrumental chemistry		

Field of study	Profile of study (general academic, practical)	Year /Semester
Chemical and Process Engineering	**general academic**	**2/3**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**compulsory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **30**	Classes: **-**	Laboratory: **30**	Project/seminars: **-**		**4**

Status of the course in the study program (Basic, major, other) (university-wide, from another field)

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**4 - 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge:**	The student has ordered knowledge in the field of inorganic chemistry, basic knowledge about the properties of chemical compounds obtained as part of the program of classes in general and inorganic chemistry. The student should have the knowledge and skills acquired in the subject of mathematics necessary in chemical calculations.
2	**Skills:**	The student uses basic chemical equipment and laboratory glassware.
3	**Social competencies:**	The student understands the need to learn and improve his/her professional and personal competences.

Assumptions and objectives of the course:
To acquaint students with basic, classic techniques and methods used in quantitative analysis.
Teaching the correct way to proceed in the methods of quantitative analysis used in the laboratory, as well as acquiring proficiency in analytical calculations.
Acquiring knowledge about instrumental techniques (discussion of basic physicochemical laws used in the presented instrumental techniques, familiarization with the principles of apparatus operation, discussion of the basic rules for the execution of determinations and analysis).

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. K_W03 The graduate has a general knowledge of analytical chemistry. The student distinguishes and is able to assess the possibility of using a given analytical method and / or instrumental technique.
2. K_W07 The graduate knows the principles of operation of control and measurement systems. The graduate understands the principle of operation of the apparatus used in instrumental techniques.

Skills:

1. K_U08 The graduate can plan and conduct simple experiments, interpret their results and draw conclusions. Selects and applies analytical methods and techniques in qualitative and quantitative analysis. Has the ability to perform qualitative and quantitative determinations.
2. K_U05 The graduate has the ability to self-study.
3. K_U12 The graduate applies principles of work in the analytical laboratory.and complies with guidelines concerning health and safety at work.

Social competencies:

1. K_K01 The graduate understands the need to develop and improve his/her professional competencies.
2. K_K03 The graduate is aware of the importance of professional conduct and respect for professional ethics.
3. K_K04 The graduate is aware of the responsibility for his/her own work and the willingness to subordinate teamwork and responsibility for jointly accomplished tasks.

Assessment methods of study outcomes

Tests for grades from each of the four branches of analytical chemistry (alkacimetry, redoximetry, complexometry and precipitation analysis). Written reports on the exercises performed.

Verbal and written control of the student's knowledge prior to the commencement of laboratory classes from instrumental analysis.

Examination at the end of the semester covering analytical and instrumental chemistry.

Course description

In the part concerning analytical chemistry

Practical aspects of analytical chemistry: basics of chemistry of solutions: ionic activity and ionic strength in solutions of strong and weak electrolytes; equilibrium in acid-base reactions, oxidation and reduction, complexation and precipitation of precipitate; methods and techniques of volumetric analysis (titration curves, indicators, analytical calculations in alkacymmetric, redoximetry, complexometric and precipitation titrations):

1. Analysis and assessment of threats occurring in work processes. Risk assessment.

2. Volumetric analysis based on reactions:

- Acid - base

Determination of total water acidity.

- Oxidation and reduction

Redoxymmetric determination of copper.

- Complexation

Co-determination of Ca2 + and Mg2 + ions and calculation of water hardness.

- precipitation of precipitates

Determination of chlorides by the Mohr method.

In the part concerning instrumental analysis

Theoretical basis of physicochemical phenomena leading to the creation of the analytical signal measured in instrumental analysis. Methods of signal measurement, analytical characterization of the method, application of a given method. Absorption and emission atomic spectrometry, UV and VIS absorption spectrophotometry, electrochemical and chromatographic methods.

1. Ion-selective electrodes - Quantitative determination of fluoride ions in toothpaste and in tap water.

2. Voltammetric determination of cadmium or lead on a film electrode.

3. Gas chromatography - optimization of the determination parameters of the chosen mixture of organic compounds.

4. Atomic absorption spectrometry - quantitative determination of manganese in wastewater.

5. Spectrophotometry - determination of nitrite nitrogen in water.

Basic bibliography:

1. A. Cygański, Metody spektroskopowe w chemii analitycznej, WNT, Warszawa 1995
2. D.A. Skoog, D.M. West, F.J.Holler, S.R. Crouch, Podstawy chemii analitycznej, T. 1 i 2, PWN, Warszawa 2006
3. A. Cygański, Podstawy metod elektroanalitycznych, WNT, 1999
4. J. Minczewski, Z. Marczenko, Chemia Analityczna. Analiza Instrumentalna, T1, 2, T.3, PWN, Warszawa 1985
5. A. Cygański, Chemiczne metody analizy ilościowej, WNT, Warszawa 2005
6. M. Wesołowski, K. Szefer, D. Zimna, Zbiór zadań z analizy chemicznej,WNT Warszawa 2002

Additional bibliography:

1. J. Dojlido, J. Zerbe, Instrumentalne metody badania wody i ścieków, Arkady, Warszawa 1997
2. W. Szczepaniak, Metody instrumentalne w analizie chemicznej, PWN, Warszawa 2002
3. A. Hulanicki, Reakcje kwasów i zasad w chemii analitycznej, PWN, Warszawa 1992
4.H. Elbanowska, J. Zerbe, J. Siepak, Fizyczno – chemiczne badania wód, Wydawnictwo Naukowe UAM, Poznań 1999

Result of average student's workload

Activity	Time (working hours)
1. lecture	30
2. consultation for the lecture	7
3. consultation for the laboratory	6
4. preparation for the laboratory	12
5. laboratory	30
6. preparation for the exam	18
7. exam	2

Student's workload

Source of workload	hours	ECTS
Total workload	105	4
Contact hours	75	0
Practical activities	30	0