COURSE DESCRIPTION CARD - SYLLABUS

Course name
Analytical chemistry and instrumental analysis [S1IChiP1>CAiAI]

Course

Field of study
Chemical and Process Engineering

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

The student has general knowledge in the field of inorganic chemistry and properties of chemical compounds gained during the classes in general and inorganic chemistry. The student should have the knowledge and skills acquired in the subject of mathematics necessary in chemical calculations. The student uses basic chemical equipment and laboratory glassware.

Course objective

To acquaint students with basic techniques and methods used in quantitative analysis. Teaching the correct way to proceed in the 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 determinations).

Course-related learning outcomes

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 operation principles of the measurement systems. the graduate understands the operation principle of the apparatus used in instrumental techniques.

Skills:
1. k_u08 the graduate can plan and conduct simple experiments, interpret the results and perform conclusions. selects and applies analytical methods and techniques in quantitative analysis. has the ability to perform quantitative analysis.
2. k_u05 the graduate has the ability to self-study.
3. k_u12 the graduate applies whs (work health and safety) principles in the analytical laboratory.

Social competences:
1. k_k01 the graduate understands the need to develop and improve his/her professional competency.
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 comply and responsibility for tasks carried out as a team.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Knowledge acquired as part of the lecture is verified during the exam at the end of the semester (carried out in a stationary or remote mode (e-Kursy platform), depending on the situation). The exam consists of four parts. The first part is analytical chemistry (alkacymetry, redoximetry, complexometry and precipitation analysis), and the other three are instrumental analysis, which includes spectroscopic, chromatographic and electrochemical techniques. Passing threshold: 50% of points.
Skills acquired as part of the laboratory classes covering analytical chemistry are verified on the basis of four final tests (carried out in a stationary or remote mode (e-Kursy platform), depending on the situation). Each test consists of 5 tasks/questions, differently scored depending on their level of difficulty. Passing threshold: 50% of points.
The knowledge acquired during laboratory classes from instrumental analysis is verified on the basis of oral answer (carried out in a stationary or remote mode (e-Kursy platform), depending on the situation). After each laboratory, the student is required to perform a written report.

Programme content

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 reactions; methods and techniques of volumetric analysis (titration curves, indicators, analytical calculations in acid-base, redox, complexometric and precipitation titrations):
1. Analysis and assessment of threats occurring in work processes. Risk assessment.
2. Volumetric analysis based on:
• Acid - base reactions: Determination of total water acidity.
• Oxidation and reduction reactions: Determination of copper.
• Complexometric reactions: Co-determination of Ca2+ and Mg2 + ions and calculation of water hardness.
• Precipitation reaction: 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 techniques.
1. Ion-selective electrodes - determination of fluoride ions in toothpaste and in tap water.
2. Voltammetric determination of ascorbic acid.
3. Gas chromatography - optimization of basic parameters of analysis of the chosen mixture of organic

compounds.
4. Atomic absorption spectrometry - determination of manganese in wastewater.
5. Spectrophotometric determination of iron(II) ions in the form of a complex with o-phenanthroline.
6. Flame atomic emission spectroscopy.

Teaching methods

1. Lecture: multimedia presentation, discussion.
2. Laboratory exercises: performing practical experiments in accordance with schedule of the subject and a written report including the appropriate chemical reactions together with mathematical calculations.

Bibliography

Basic
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. Tom 1 i 2, PWN, Warszawa 2006
3. A. Cygański, Podstawy metod elektroanalitycznych, WNT, 1999
4. J. Minczewski, Z. Marczenko, Chemia Analityczna. Tom 1, 2 i 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
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

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50