



SYLLABUS

“Chemistry (Analytical)”

Degree of Higher Education - Bachelor

Specialty **101 Ecology**

Educational program - no

Year of training – the second; Semester: 4

Learning form – full-time

Amount of the ECTS credits 4

Language of instruction - English

Supervisor
Supervisor's contact
information (e-mail)
eLearn Course URL

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<https://elearn.nubip.edu.ua/course/view.php?id=2667>

DESCRIPTION OF COURSE

Analytical chemistry (chemical analysis) is the area of chemistry responsible for characterizing the composition of matter, both qualitatively (what is present) and quantitatively (how much is present). Course includes: (1) the qualitative tests of cations and anions; (2) methods of identification of soluble and insoluble substances; (3) gravimetric analysis; (4) volumetry (neutralization, RedOx methods, precipitation titrimetry; complexometry).

Competencies of the educational programme:

Integral competency (IC): The ability to solve complex specialized problems and solve practical problems in the field of ecology, environmental protection, and sustainable environmental management, which involves the application of basic theories and methods of science about environments that are characterized by complexity and uncertainty of conditions.

General competences (GC):

GC1. Knowledge and understanding of the subject area and professional activity

GC8. Ability to conduct research at the appropriate level

GC10. The ability to evaluate and ensure the quality of performed works.

Professional (special) competences (PC):

PC2. Ability to critically understand basic theories, methods and principles of natural sciences.

PC 3. Ability to understand basic theoretical concepts regulations, concepts and principles of natural and of social and economic sciences.

PC7. Ability to monitor and evaluate current condition of environment based on analytical monitoring data.

Program learning outcomes (PLO) of the educational programme:

PLO 3. Understand the basic concepts, theoretical and practical problems in the field of natural sciences, which are necessary for analysis and decision-making in the field of ecology, environmental protection and balanced nature management.

PLO14. Be able to create texts, make presentations and messages for professional audiences and the general public with observance of professional integrity and impossibility plagiarism.

PLO18. Combine the skills of independent and teamwork to achieve results with an emphasis on professional integrity and responsibility for decision-making.

PLO19. Increase the professional level by continuing education and self-education.

PLO21. To be able to choose optimal methods and tools for research, collection and data processing.

STRUCTURE OF COURSE

Chapter	Hours (lectures/labs)	Results of learning	Tasks	Grading, scores
The spring semester, the 2^d year of study				
Module the 1st. The Foundations of the Qualitative Analysis				
Chapter 1. Subjects and objects of the chemical analysis (analytical chemistry). Methods of quantitative analysis.	4/2	To know the safe rules in chemical laboratory; classification of the qualitative tests of cations and anions, basic techniques of the qualitative analysis; their series and limitation factors To know how to organize the working place and realize the lab techniques of semimicro qualitative tests To analyze the advantages and disadvantages of the different analytical techniques; the importance of sensitivity and selectivity of analytical reactions	Elern testing	2

		To understand the importance of the chemical analysis in the environmental sciences and planning of the environment monitoring strategy. To apply the qualitative analytical tests		
Chapter 2. Qualitative analysis of cations and anions.	2/10	To know the principles of the analytical separations and determinations of the cations and anions To have skills of analytical manipulations at the analysis of aqua mixtures; choose and apply appropriate separation - and detection method to solve simple problems; To understand the pathway of systematic qualitative chemical analysis	Experimental tasks – analysis of cations mixture; chemical qualitative analyses of soluble salts, water solutions and insoluble substances	8
Chapter 3. Analytical purity of reagents. Ukrainian and international degrees of purity. The methodology of cation mixture analysis. Partial and Systematic analysis. The strategy of cation mixture separation	4/10	To know the requirements to the analytical reagents; the main qualitative tests of cations and anions To understand the general principles of the creation for the experimental pathway of inorganic substances qualitative analysis To have skills to determine the qualitative composition of inorganic oxides, salts, acids, alkalis, account for some common sampling strategies for inorganic compounds	Module control tests Elern testing	6
Total 1st module	10/22			16
Module the 2^d. The Foundations of the Gravimetric Quantitative Analysis				
Chapter 1. Expression of Concentration in chemical and environmental analysis. Formulas of recalculations of concentration units. Preparation of solutions. Calculation in quantitative analysis.	2/2	To know the content and math expression of the main units of concentrations; Should be able to transform one unit into other ones; To analyze quantitative calculations via units of concentrations; To understand the application fields of the different units; To apply the qualitative expressions for the environmental objects; To use the basic ideas for the solution of calculations in qualitative analysis	Module control tests Elern testing	2
Chapter 2. Heterogeneous equilibrium. Molar and mass solubility. Factors effecting solubility.	4/2	To know the idea of solubility predicting based of value of solubility product; how to regulate solubility by acting of inner factors. To understand the natural processes controlled by precipitation and dissolving of slightly soluble substances. To apply calculated solubility for the creating of chemical barrier against anthropogenic pollution	Module control testing. Elern testing	12
Chapter 3. Gravimetric analysis.	2/6	To understand the pathway of gravimetric qualitative analysis. To have skills in physical and precipitation gravimetry	Experimental task – determination of barium content in barium chloride.	8
Total the 2^d module	8/8			22
Module the 3^d. The Foundations of the Volumetric Quantitative Analysis				
Chapter 1. Homogeneous equilibrium in solutions.	4/0	To know the foundations of the homogeneous equilibrium in solution; application of equivalent law in volumetry. To understand the concent of a pH; ionic product of water; biological function depending pH; concent of a pH buffering; acid-basic indicators. To should be able to measure a pH, to calculate the titration curves, to determine equivalent points, titration jump; to choice the acid-base indicators. To have skills of pH calculations (e.g., strong	Module control testing. Elern testing	12

		acids and bases, weak acids and bases, hydrolyzed salts; buffer solutions); to prepare buffer solutions.		
Chapter 2. Volumetry methods: theoretical foundations and application	8/15	To know the theory of volumetric quantitative methods (neutralization, RedOx, complexometry); To have practical skills of qualitative determinations used above mentioned analytical methods; To understand the features of above mentioned methods application in the environmental analyses; To use the math treatment of experimental results.	Experimental tasks, theoretical quizzes, elem testing	20
Total the 3rd module	12/15			32
Total for 1 semester				70
Exam				30
Total for course				100

ASSESSMENT POLICY

<i>Policy regarding deadlines and results:</i>	Assignments submitted after the deadline without valid reasons will be graded lower. Resitting of modules will be allowed with the permission from the lecturer and in the presence of valid reasons (e.g. medical reasons).
<i>Academic honesty policy:</i>	Cheating during tests and exams is strictly prohibited (including the use of mobile devices). Coursework and research papers must contain correct citations for all sources used.
<i>Attendance policy:</i>	Class attendance is mandatory. In case of objective reasons (such as illness or international internships), individual learning may be allowed (in online format by the approval of the dean of the faculty).

SCALE OF ASSESSMENT OF STUDENT KNOWLEDGE

Student rating, points	National grade based on exam results	
	exams	credits
90-100	excellent	passed
74-89	good	
60-73	satisfactory	
0-59	unsatisfactory	not passed

RECOMMENDED SOURCES OF INFORMATION

- Analytical Chemistry. Manual for Bachelor's Students // Voytenko I.V., Kosmaty V.E., Kopilevich V.A. – Kyiv: NAUU publ., 2007. – 199 pp.
 - Analytical Chemistry. Workbook for Bachelor's Students // Voitenko I.V., Kosmaty V.E., Savchenko D.A., Kopilevich V.A. – Kyiv: NUBiP Publ., 2014. – 140 pp.
 - Harvey D. Modern Analytical chemistry (electron copy). McGraw-Hill Education, 2000. – 556 pp.
 - Ф.Г. Жаровський, А.Т. Пилипенко, І.В. П'ятницький. Аналітична хімія. – К.: "Вища школа", 1982. – 543 с.
 - Vogels' Textbook of Macro and semimicro qualitative inorganic analysis <https://archive.org/details/VogelsQuantitativeChemicalAnalysis>
 - Harvey D. An Eelectronic Textbook for Introductory Cources in Analytical chemistry. <http://www.freebookcentre.net/chemistry-books-download/An-Electronic-Textbook-for-Introductory-Courses-in-Analytical-Chemistry.html>
 - Quantitative Analysis Analytical Chemistry by Dr. Michael J. Prushan <http://www.freebookcentre.net/chemistry-books-download/Quantitative-Analysis-Analytical-Chemistry.html>
 - Prof. Clemens F Kaminski Analytical Chemistry Notes [http://www.freebookcentre.net/chemistry-books-download/Analytical-Chemistry-Notes-\(PDF-55P\).html](http://www.freebookcentre.net/chemistry-books-download/Analytical-Chemistry-Notes-(PDF-55P).html)
 - ISO 6353-2:1983 Reagents for chemical analysis – Part 2: Specifications – First series.
 - ISO 6353-2:1983/Add.2:1986(en) Reagents for chemical analysis — Part 2: Specifications — First series
- ADDENDUM 2.

9. ISO 6058:1984. Water quality – Determination of calcium content – EDTA titrimetric method.
10. ISO 6059:1984 Water quality – Determination of the sum of calcium and magnesium – EDTA titrimetric method.
11. Periodical Table - <http://www.webqc.org/periodictable.php>.
12. Calculator of Molar weight (FW) <http://www.graphpad.com/quickcalcs/Molarityform.cfm>
13. Units convertor - <http://www.webqc.org/unitconverters.php>.
14. pH calculator - <http://www.webqc.org/phsolver.php>.
15. Calculating titrating curves - http://chemwiki.ucdavis.edu/Core/Physical_Chemistry/Equilibria/Acid-Base_Equilibria/pH_Titration_Curves.
16. Acid-base indicators - <http://www.ch.ic.ac.uk/vchemlib/course/indi/indicator.html>
17. RedOx indicators choice - <http://community.asdlib.org/imageandvideoexchangeforum/2013/07/26/selecting-an-indicator-for-8a-redox-titration/>
18. Sigma-Aldrich reagents - <https://www.sigmaaldrich.com/>