MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
LUTSK NATIONAL TECHNICAL UNIVERSITY
FACULTY OF CUSTOMS, MATERIALS, TECHNOLOGIES AND HOSPITALITY

APPROVED
Dean of the Faculty
_____ Valentyna TKACHUK
29.08.2026

APPROVED
First Vice-Rector
_____ Nadiia KOVALCHUK
29.08.2026

SYLLABUS

of the educational component "Analytical Chemistry"
higher education degree – Bachelor
field of knowledge – G Engineering, Manufacturing and Construction
specialty – G13 Food proccesing
educational programme – Expertise of food products and food raw materials

Department of Food Technologies and Chemistry

Syllabus developed by Associate Professor, PhD Iryna MOROZ

The syllabus was approved at the meeting of the Department of Food Technologies and Chemistry, minutes No. 13 of 29.08.2026

Head of the Department DSc, Professor Ihor DUDARIEV

Reviewed and approved by the support group of the educational programme "Expertise of food products and food raw materials", minutes No. 5 of 29.08.2026

Guarantor of the educational programme "Expertise of food products and food raw materials" PhD, Associate Professor Svitlana PANASIUK

Approved by the Scientific and Methodological Council of the University, minutes No. 1/a of 29.08.2026

Approved syllabus online:
https://e.lntu.edu.ua/syllabus/2168

Lutsk – 2026

SYLLABUS OF THE EDUCATIONAL COMPONENT "Analytical Chemistry"

Educational programme	Expertise of food products and food raw materials
Field of knowledge / Specialty	G Engineering, Manufacturing and Construction / G13 Food proccesing
Level of higher education	first (bachelor's)
Course status	compulsory
Language of instruction	English
Workload	7 ECTS credits / 210 hours, semester 2
Form of final assessment	exam
Lecturer(s)	PhD, Associate Professor Iryna MOROZ

1. Course aim and objectives

Aim: To develop students' knowledge of the theoretical foundations of qualitative and quantitative analysis methods; to master the technique of performing basic analytical operations. Application of qualitative and quantitative analysis methods in food technologies.

Objectives: – to highlight the most important theoretical principles of analytical chemistry and its significance for the development of food technologies;
– to develop students' knowledge of the main methods of qualitative and quantitative analysis;
– to familiarize students with the technique of performing the most important analytical operations, to develop skills for independent work in a chemical laboratory, as well as for the evaluation and generalization of the obtained results;
– to introduce the main directions of applying analytical research methods in food production;
– to develop skills in applying the acquired knowledge of analytical chemistry during the further study of professional disciplines;
– to form an understanding of the application of physicochemical research methods for the qualitative and quantitative analysis of food products.

Prerequisites: Inorganic and Organic Chemistry

2. Competences

IC — integral competence: The ability to solve complex specialized tasks and practical technical and technological problems characterized by complexity and uncertainty in the operating conditions of food industry and food service enterprises, as well as in the learning process, requiring the application of theoretical principles and methods of food technology.

GC01 — Knowledge and understanding of the subject area and professional practice.

GC02 — Ability to learn and acquire up-to-date knowledge.

GC05 — Ability to search for and analyze information from various sources.

GC06 — Ability to assess and ensure the quality of work performed.

GC07 — Ability to work in a team.

GC08 — Ability to work independently.

GC09 — Skills in ensuring safety in the workplace.

SC03 — Ability to organize and conduct quality and safety control of raw materials, semi-finished products, and food products using modern methods.

SC08 — Ability to conduct research in specialized laboratories to solve applied problems.

3. Course structure, distribution of hours, links between topics and competences

No.	Topic	Lectures full-time/ part-time	Lab. full-time/ part-time	Self-study full-time/ part-time	Total	Teaching methods	Assessment methods	GC and SC
Content module 1. Qualitative Chemical Analysis								
1	Topic 1. Subject of Analytical Chemistry. Place of Analytical Chemistry Among Natural Sciences	2/–	2/–	11/15	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
2	Topic 2. Classification of Cations, Qualitative Reactions of Cations of Analytical Groups I–III	2/1	4/1	9/13	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
3	Topic 3. Qualitative Reactions of Cations of Analytical Groups IV–VI	2/–	4/1	9/14	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
4	Topic 4. Regularities of Chemical Reactions in Homogeneous Systems. Acid-Base Interaction Reactions	2/1	2/–	11/14	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
5	Topic 5. Oxidation-Reduction Reactions. Precipitation and Dissolution of Sparingly Soluble Compounds	3/1	4/–	8/14	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
6	Topic 6. Qualitative Reactions of Anions of Analytical Groups I–III	2/–	2/1	11/14	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08

No.	Topic	Lectures full-time/ part-time	Lab. full-time/ part-time	Self-study full-time/ part-time	Total	Teaching methods	Assessment methods	GC and SC
7	Topic 7. Sample Preparation for Analysis and Systematic Analysis of a Substance	2/–	4/1	9/14	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
Content module 2. Quantitative Analysis								
8	Topic 8. Subject and Objectives of Quantitative Chemical Analysis. Gravimetric Method of Analysis	2/–	4/–	9/15	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
9	Topic 9. Chemical Titrimetric Methods of Analysis. Acid-base titration method	2/1	4/2	9/12	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
10	Topic 10. Redox Titration Methods	2/–	2/1	11/14	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
11	Topic 11. Complexometric and Precipitation Methods of Titrimetric Analysis	2/–	4/1	9/14	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
12	Topic 12. Electrochemical Methods of Analysis	2/1	3/1	10/13	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08

No.	Topic	Lectures full-time/ part-time	Lab. full-time/ part-time	Self-study full-time/ part-time	Total	Teaching methods	Assessment methods	GC and SC
13	Topic 13. Optical Methods of Analysis	3/1	4/1	8/13	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
14	Topic 14. Separation and Preconcentration Methods. Chromatography	2/–	2/–	11/15	15/15	TM1, TM2, TM3, TM4, TM5, TM6	AM2, AM4	GC01, GC02, GC05, GC06, GC07, GC08, GC09, SC03, SC08
	Total	**30/6**	**45/10**	**135/194**	**210/210**			

Legend: GC — general competence (number according to section 2); SC — special (professional) competence (number according to section 2). The full wording of each code is given in the educational programme / standard of the specialty.

Teaching methods: TM1 — verbal method (lecture, discussion, interview, etc.); TM2 — practical method (laboratory and practical classes); TM3 — visual method (illustration and demonstration); TM4 — work with educational and methodological literature (note-taking, abstracts, annotations, reviews, essays); TM5 — video method combined with up-to-date information technologies and computer-based learning tools (distance, multimedia, web-based, etc.); TM6 — independent work (problem solving).

Assessment methods: AM2 — oral or written survey; AM4 — testing.

4. Learning outcomes

PLO01. To know and understand the fundamental concepts, theoretical foundations, and practical issues in the field of food technology.

PLO02. To demonstrate creative initiative and enhance professional competence through continuing education and self-directed learning.

PLO03. To apply information and communication technologies to support professional activities and conduct applied research.

PLO04. To search for and process scientific and technical information from various sources and apply it to solve specific technical and technological problems.

PLO05. To understand the scientific principles underlying food processing operations and the mechanisms of physicochemical, biochemical, and microbiological transformations of the main components of food raw materials during processing.

PLO11. To determine whether the quality indicators of raw materials, semi-finished products, and finished products comply with regulatory requirements using modern analytical and quality control methods.

PLO16. To comply with occupational safety regulations and implement technical and organizational measures to ensure safe working conditions in production activities.

PLO18. To have basic skills in conducting theoretical and/or experimental research, individually and/or as part of a research team.

PLO19. To improve work efficiency by combining independent and teamwork approaches.

5. Sustainable Development Goals

SDG 4 – Quality Education

SDG 6 – Clean Water and Sanitation

6. Non-formal education

Regarding recommended courses, training sessions, internships, and other activities: learning outcomes acquired through formal, non-formal, or informal education may be recognized in accordance with LNTU procedures. Proof may consist of certificates from specialized training sessions, webinars, or online courses, accompanied by a description of the achieved learning outcomes and, if necessary, a brief verification task or a portfolio.
Recommended Courses: General Chemistry and General Chemistry-2 – online courses on the platform of TU Bergakademie Freiberg (Freiberg, Germany) [Online]. Available from: https://suuuport.de/general-chemistry ; https://suuuport.de/general-chemistry-2.

7. Assessment criteria and forms of control

Assessment is based on a 100-point scale (national scale / ECTS). Final grade = continuous assessment (30 %) + individual assignments (10 %) + module tests (30 %) + exam (30 %).

Academic integrity: independent completion of assignments; correct citation of sources; marking parts of the text generated by AI tools. Violations of academic integrity are not tolerated.

8. Content of topics

Topic 1. Subject of Analytical Chemistry. Place of Analytical Chemistry Among Natural Sciences

The main stages of development of analytical chemistry. Current state and development trends of analytical chemistry. Chemical, physicochemical, and physical methods of analysis. Macro-, micro-, and ultramicroanalysis. Analytical signal. Sensitivity as a characteristic of the analytical signal and detection limit. Fractional and systematic methods of analysis.

Topic 2. Classification of Cations, Qualitative Reactions of Cations of Analytical Groups I–III

Classification of cations into analytical groups. Qualitative reactions for cations of the first analytical group. Qualitative reactions for cations of the second analytical group. Qualitative reactions for cations of the third analytical group. Systematic scheme of analysis for a mixture of cations of analytical groups I–III.

Topic 3. Qualitative Reactions of Cations of Analytical Groups IV–VI

Qualitative reactions for cations of the fourth analytical group. Systematic analysis of a mixture of cations of the fourth analytical group. Qualitative reactions for cations of the fifth analytical group. Qualitative reactions for cations of the sixth analytical group. Systematic scheme of analysis for a mixture of cations of analytical groups IV–VI.

Topic 4. Regularities of Chemical Reactions in Homogeneous Systems. Acid-Base Interaction Reactions

Solution as a medium for chemical reactions. Debye-Hückel theory. Activity coefficients. Concentration constants. Total and equilibrium concentrations. Conditional constants. Rate of chemical reactions in solutions. Theories of acids and bases (Arrhenius-Ostwald, Brønsted-Lowry, Lewis, Usanovich). Acidity and basicity constants. Autoprotolysis constant of water. pH value. Buffer solutions and their application in chemical analysis. Buffer capacity. Equilibria in solutions of salts undergoing hydrolysis.

Topic 5. Oxidation-Reduction Reactions. Precipitation and Dissolution of Sparingly Soluble Compounds

General characteristics of oxidation-reduction (redox) reactions. Redox potentials. Nernst equation. Equilibrium constants of redox reactions. Influence of various factors on the rate of redox reactions. Equilibrium in solutions of sparingly soluble electrolytes. Calculation of electrolyte solubility and its solubility product constant. Influence of the common ion concentration on electrolyte solubility. Influence of foreign electrolytes and pH on the solubility of precipitates. Fractional precipitation.

Topic 6. Qualitative Reactions of Anions of Analytical Groups I–III

Classification of anions into analytical groups. Qualitative reactions of anions of the first analytical group. Qualitative reactions of anions of the second analytical group. Qualitative reactions of anions of

the third analytical group. Systematic analysis of a mixture of anions of analytical groups I–III.

Topic 7. Sample Preparation for Analysis and Systematic Analysis of a Substance

Types of samples. Sampling of air, water, soil, snow cover, and food products. General principles of sample preparation for analysis. Methods of separation and preconcentration. Scheme for the systematic analysis of a substance.

Topic 8. Subject and Objectives of Quantitative Chemical Analysis. Gravimetric Method of Analysis

Precipitates and their properties. Scheme of precipitate formation. Conditions for the formation of precipitates (amorphous and crystalline). Dependence of precipitate structure on individual properties and precipitation conditions. Contamination of precipitates. General characteristics of the gravimetric method of analysis. Requirements for the precipitation form and the gravimetric (weighing) form. Precipitation methods. Calculations in gravimetry, gravimetric factor (conversion factor).

Topic 9. Chemical Titrimetric Methods of Analysis. Acid-base titration method

Basic titration techniques (direct, back, displacement). Standardization of titrant solutions. Calculations in chemical analysis. Processing data of quantitative chemical analysis. General characteristics of the acid-base titration method, standard solutions. Acid-base indicators. Methods of indicator selection. Titration curves.

Topic 10. Redox Titration Methods

General characteristics of the redox titration method, standard solutions. Permanganatometry. Iodometry. Features of preparing standard solutions. Redox indicators and their selection. Examples of determinations. General characteristics of bromatometry, chromatometry, and cerimetry. Methods for endpoint detection. Titration curves.

Topic 11. Complexometric and Precipitation Methods of Titrimetric Analysis

Application of complex compounds in analytical chemistry. Stability of complex compounds, equilibria in solutions. Complexation and complexometric titration methods. Methods for endpoint detection. Preparation of the standard working solution of EDTA (Trilon B). Titration curves.

Topic 12. Electrochemical Methods of Analysis

Classification of electrochemical methods. Potentiometric methods of analysis. Glass electrode and potentiometric pH determination. Ionometry and ion-selective electrodes. Potentiometric titration. Electrogravimetry. Conductometry. Voltammetry. Coulometry. Theoretical foundations of the methods.

Topic 13. Optical Methods of Analysis

Classification of methods. Absorption, emission, and scattering of light. Beer-Lambert law (Bouguer-Lambert-Beer law). Photometry. Selection of photometric reaction and measurement conditions for optical density (absorbance). Photometric methods of quantitative analysis. Spectrochemical analysis: molecular absorption spectrometry, mass spectrometry, molecular fluorescence spectroscopy, atomic spectroscopy.

Topic 14. Separation and Preconcentration Methods. Chromatography

Theoretical foundations of chromatographic analysis. Classification of methods. Quantitative and qualitative determination using chromatograms. Thin-layer chromatography (TLC). Ion-exchange chromatography. Liquid-liquid partition chromatography. Capabilities of chromatography.

9. Individual assignments

Completing the Comprehensive Practical Individual Assignment (CPIA) in the discipline is a mandatory prerequisite for the successful mastery of the course and for obtaining a passing grade. The CPIA involves the systematic comprehension and practical application of the knowledge, skills, and abilities acquired by the higher education student throughout the study of the discipline.

The objective of the CPIA is to apply the theoretical knowledge of the discipline to solving problems and exercises, develop independent study skills, systematize knowledge, and ensure an in-depth study of specific topics within the course. The task of the CPIA consists in solving computational problems in analytical chemistry. Task variants and examples of problem-solving are provided in the guidelines for

independent study for the discipline "Analytical Chemistry".

The CPIA constitutes a separate credit module of the academic discipline. The individual assignment is defended during the semester during the hours allocated for individual work. While completing and formatting the individual assignment, the student may utilize the recommended literature, study guidelines, and internet resources.

The CPIA is evaluated on a 100-point scale. The completion of the CPIA is one of the mandatory component modules of the ECTS credit.

10. Self-study

Types of independent work: studying educational and scientific literature; preparing for laboratory sessions; completing individual assignments; solving calculation problems; preparing presentations; preparing for modular and final assessments.

Forms of reporting and assessment: oral questioning and interviews; review of completed laboratory work; review of individual assignments; testing; presentation evaluation; modular assessment; final assessment.

11. General requirements

The educational process is governed by the academic regulations of LNTU. Students are required to read the requirements set out in the LNTU Code of Academic Integrity and the LNTU Policy on the Ethical Use of Artificial Intelligence, and to adhere to the principles of academic integrity and the ethical use of artificial intelligence in their educational activities.

Academic integrity. Participants of the educational process must comply with the Law of Ukraine “On Academic Integrity” of 18.12.2025 No. 4742-IX and the internal regulations of LNTU. Academic plagiarism, fabrication, falsification, misappropriation of authorship, non-independent completion of assignments, as well as dishonest use of results generated by artificial intelligence are not allowed.

Use of artificial intelligence. Artificial intelligence tools may be used to search for ideas, explain methods, provide preliminary structuring, language editing and auxiliary analysis of non-confidential data, unless a specific assignment requires fully independent work. Students must indicate the tool used, the purpose and the stage of its use, check facts and calculations, and justify their conclusions independently.

12. References

I. Teaching and methodological materials

Works by the syllabus author:

1. Analytical chemistry : lecture notes for applicants for the first (bachelor's) level of higher education of the educational and professional programme «Food Technologies» of the field of knowledge 18 Production and Technologies, specialty 181 Food Technologies of full-time and part-time study / compiled by I. A. Moroz. Lutsk : lNTU, 2024. 112 p. URL: https://repository.lntu.edu.ua/handle/123456789/1915

2. Analytical chemistry : method. instructions for laboratory classes for applicants for the first (bachelor's) level of higher education of the educational and professional program "Food Technologies" of the field of knowledge 18 Production and Technologies, specialty 181 Food Technologies full-time and part-time forms of study / compiled by I. A. Moroz. Lutsk : LNTU, 2023. 72 p. URL: https://repository.lntu.edu.ua/handle/123456789/1351

3. Analytical chemistry : methodical instructions for independent work for applicants for the first (bachelor's) level of higher education of the educational and professional programme "Food Technologies" of the field of knowledge 18 Production and Technologies, specialty 181 Food Technologies full-time and part-time forms of study / compiled by I. A. Moroz. Luts : LNTU, 2023. 44 p. URL: https://repository.lntu.edu.ua/handle/123456789/1349

4. Харчові технології : навч. посіб. / С. Є. Голячук, Ю. Л. Гунько, І. М. Дударєв та ін. Луцьк : ЛНТУ, 2026. 464 с. URL: https://repository.lntu.edu.ua/handle/123456789/2405

Works by other authors:

5. Аналітична хімія. Якісний аналіз неорганічних та органічних речовин: навчальний посібник для студентів вищих навчальних закладів / М. В. Шевряков, Г. О. Рябініна, С. М. Іванищук, М. В. Повстяной. Херсон : Олді-Плюс, 2024. 516 с.

6. Аналітична хімія. Теоретичні основи якісного та кількісного аналізу: навчальноо- методичний посібник / М. В. Шевряков, М.В. Повстяной, Б. В. Яковенко, Т. А. Попович. Херсон : Олді-Плюс, 2024. 404 с.

7. Більченко М. М. Практикум з аналітичної хімії. Кількісний аналіз: Навчальний посібник. К: Університетська книга, 2023. 142 с.

8. Більченко М. М., Пшеничний Р.М. Аналітична хімія. Задачі та вправи: Навчальний посібник. К: Університетська книга, 2023. 205 с.

9. Сухан В.В., Трохименко О.М., Трохименко А.Ю. Аналітичні реагенти й техніка приготування їхніх розчинів / За редакцією Тананайко О.Ю. Київ: ВПЦ «Київський університет», 2022. 592 с.

10. Otto M. Chemometrics: statistics and computer application in analytical chemistry. John Wiley & Sons, 2023. 432 p.

11. Rouessac F., Rouessac A., Towey J. Chemical Analysis: Modern Instrumentation Methods and Techniques, 3rd Edition. Willey. 2022. 624 p.

II. Scientific works

Works by the syllabus author:

12. Shemet V., Moroz I., Hulai O. Chapter 5. Compositional analysis and potential of buckwheat and oats as functional food ingredients. Innovative approaches in food processing and sustainability : monograph. Tallinn. 2025. P. 92-112. URL: https://repository.lntu.edu.ua/handle/123456789/2072

13. Moroz, I. Optimising the adsorption characteristics of spent coffee grounds by thermal and chemical activation. Commodity Bulletin. 2025. Vol.18, № 1. P. 43-50. URL: https://repository.lntu.edu.ua/handle/123456789/1339

14. Moroz, I., Shemet, V., Dudarev, I., Hulai, O. (2024). Comparison of properties of plant-based milk and cow's milk. Scientific Works of NUFT, 30(5), 152-163. https://doi.org/10.24263/2225-2924-2024-30-5-13

15. Мороз І., Шемет В., Гулай О. Вітамін с: структура, біохімічне значення, методи визначення. Праці НТШ. Хімічні науки. 2024. Т. LXXV. С. 78-89. URL: https://repository.lntu.edu.ua/handle/123456789/1390

16. Moroz I. The Analysis of Approaches to Assessing the Sugar Content of Fruit and Vegetable Products. Commodity Bulletin. 2024. Vol. 17, № 1. P. 36-43. https://doi.org/10.62763/ef/1.2024.36

Works by other authors:

17. Ahluwalia, V. K. Instrumental methods of chemical analysis Berlin/Heidelberg, Germany: Springer. 2023. pp. 179-231.

III. Information resources

18. NIST, Physical Reference Data Database https://www.nist.gov/pml/productsservices/physical-reference-data

19. Labster / Virtual Labs for University https://www.labster.com

20. Periodic Table http://ptable.com