**SYLLABUS**

**Spring semester 2021-2022 academic years**

**on the educational program 6B07202 “Food chemistry and technology (NKU)”**

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| **Discipline’s code** | **Discipline’s title** | **Independent work of students (IWS)** | **No. of hours per week** | | | | | **Number of credits** | **Independent work of student with teacher (IWST)** |
| **Lectures (L)** | **Practical training (PT)** | | **Laboratory (Lab)** | |
| **OAH 1205** | Fundamentals of analytical chemistry | 7 | 15 | 0 | | 60 | | 5 | 6 |
| **Academic course information** | | | | | | | | | |
| **Form of education** | **Type of course** | **Types of lectures** | | | **Types of practical training** | | **Number of IWS** | | **Form of final control** |
| Online, combined | Practical | Online | | | Offline | | 7 | | Test |
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| **Academic presentation of the course** |

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| **Aim of course** | **Expected Learning Outcomes (LO)**  As a result of studying the discipline the undergraduate will be able to: | **Indicators of LO achievement (ID)**  (for each LO at least 2 indicators) |
| formation of the ability to justify the choice of method of analytical control of materials on the basis of analytical characteristics. | 1. explain the principles and methods of analytical chemistry; | 1.1 use of terms in analytical chemistry;  1.2 ability to choose chemical containers, equipment;  1.3 ability to write an analytical reaction; ability to use the received information |
| 2. understand the basics of methods of qualitative and quantitative analysis of inorganic and organic substances, including methods of physical and chemical analysis; | 2.1 understand the basics of qualitative and quantitative analysis  2.2 ability to determine the equivalent by chemical reaction;  2.3 calculation and execution of solution preparation  2.4 ability to distinguish the scope of the analysis |
| 3. carry out qualitative and quantitative analysis of chemicals; | 3.1 perform calculations for the analysis of substances, taking into account the impact factors;  3.2 selection of the optimal condition of the test component in the substance |
| 4. process the results of the analysis of various substances through statistical processing; | 4.1 performance of chemical processes;  4.2 correctly identify the stages of analysis, use the order of execution;  4.3 be able to statistically process the results |
| 5. present the results in the form of summary reports and presentations. | 5.1 eliminate the effects of extraneous components for multicomponent systems, perform analysis;  5.2 prove the accuracy of the results of the analysis, be able to report |
| **Prerequisites** | General chemistry, inorganic chemistry, mathematics | |
| **Post requisites** | Organic chemistry, physical chemistry | |
| **Information resources** | 1. S. S. Mahajan. Instrumental Methods of Analysis. - Popular Prakashan Limited, 2010 – 458 p.  2. D. Muralidhara Rao, A. V. N. Swamy, D. Dharaneeswara Reddy. Instrumental Methods of Analysis. - CBS Publishers & Distributors, 2020. – 384 p.  3. D. A. Skoog, ‎F.J. Holler, ‎S.R. Crouch. Principles of Instrumental Analysis. – Cencage, 2017.  4. F. Rouessac, A. Rouessac. Chemical Analysis: Modern Instrumentation Methods and Techniques. – Wiley, 2013. | |

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| **Academic policy of the course in the context of university moral and ethical values** | **Academic Behavior Rules:**  All students have to register at the MOOC. The deadlines for completing the modules of the online course must be strictly observed in accordance with the discipline study schedule.  ATTENTION! Non-compliance with deadlines leads to loss of points! The deadline of each task is indicated in the calendar (schedule) of implementation of the content of the curriculum, as well as in the MOOC.  **Academic values:**  - Practical trainings/laboratories, IWS should be independent, creative.  - Plagiarism, forgery, cheating at all stages of control are unacceptable.  - Students with disabilities can receive counseling at e-mail m.abilev@mail.ru. |
| **Evaluation and attestation policy** | **Criteria-based evaluation:**  assessment of learning outcomes in relation to descriptors (verification of the formation of competencies in midterm control and exams).  **Summative evaluation:** assessment of work activity in an audience (at a webinar); assessment of the completed task. |

**CALENDAR (SCHEDULE) THE IMPLEMENTATION OF THE COURSE CONTENT:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Weeks | Topic name | LO | AI | Amount of hours | Maximum score | Form of knowledge assessment | The  form of the lesson  / platform |

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| **Module 1** | | | | | | | |
| 1 | **L.1** The role of analytical chemistry in the assessment of the composition and quality of substances. Types of classification of methods of analytical chemistry. The law of interaction of masses. Equilibrium constants in homogeneous systems. | LО 1 | AI 1.1 | 1 |  |  | MS Teams |
| 1 | **Lab 1** Image of a specialist in a chemical laboratory, safety rules, acquaintance with the chemical containers used in the analysis, the principles of washing, storage. Purity of chemical reagents. Importance of qualitative analysis. Methods of obtaining analytical signals. | LО 1  LO 2 | AI 1.1  AI 1.2  AI 1.3  AI 2.4 | 4 | 5 | Analysis | MS Teams |
| 1 | **IWS 1.** Analytical methods in food chemistry technology (abstract) |  |  |  | 5 | IT |  |
| 1 | **IWSP 1** Consultation on the implementation of IWS1 |  |  |  |  |  | MS Teams |
| 2 | **L.2** Acid-base balance. Bransted-Lowry's protolytic theory. Ways to determine the pH of electrolytes of different nature. | LО 1 LО 2 | AI 1.1  AI 2.1 | 1 |  |  | MS Teams |
| 2 | **Lab 2** Qualitative analysis of cations | LО 2 | AI 2.1 | 4 | 5 | QS | MS Teams |
| 2 | **IWS 2.** A set of problems for determining the concentration constant, ionic strength, the amount of solution. |  |  |  | 10 |  |  |
| 3 | **L.3** Ways to determine the pH of ampholytes, buffer solutions. Buffer capacity | LО 1 LО 2 | AI 1.1  AI 2.1 |  |  |  | MS Teams |
| 3 | **Lab 3** Qualitative analysis of anions | LО 2 | AI 2.1 | 4 | 5 | QS | Lab 111 |
| 3 | **IWSP 2** Consultation on the implementation of IWS3 | LО 1 | AI 1.1 | 1 |  |  | MS Teams |
| 3 | **IWS 3.** A set of problems for determining the pH of weak and strong electrolytes, buffer solutions, ampholytes. | LО 4 | AI 4.1  AI 4.2 |  | 10 | IT | - |
| 4 | **L.4** Titrimetric methods of analysis. Acid-base titration. Draw the titration curve and analyze it. Acid-base indicators. | LО 1 LО 2 | AI 1.1  AI 2.1 | 1 |  |  | MS Teams |
| 4 | **Lab 4** The concept of the solution, ways of preparation. Methods of measuring samples on analytical and technical scales. Preparation of solutions of different concentrations (definite and indefinite), preparation of solutions from fixanal. | LО 2 | AI 2.1 | 4 | 10 | QS | Lab 111 |
| 4 | **Control work** (ionic strength, concentration constant, pH of solutions) |  |  |  | 20 |  |  |
| 5 | **L.5** Acid-base titration for organic compounds. Methods for determining the end point of titration. Theory of indicators. The role of acid-base titration in the assessment of the composition and quality of substances. | LО 1 LО 2 | AI 1.1  AI 2.1 | 1 |  |  | MS Teams |
| 5 | **Lab 5** Hydrochloric acid standardization by boron. Sodium carbonate titration.  Colloquium | LО 2  LO 3 | AI 2.1  AI 2.4  AI 3.1 | 4 | 30 | QS | Lab 111 |
| 5 | **FC 1** |  |  |  | 100 |  |  |
| 6 | **L.6** Complex formation reactions, basic concepts. Equilibrium in complex compound solutions, influencing factors. | LО 1 LО 2 | AI 1.1  AI 2.1 | 1 |  |  | MS Teams |
| 6 | **Lab 6** Standardization of sodium hydroxide solution using standard hydrochloric acid.  Determination of titratable acidity of bakery products | LО 2 | AI 2.1  AI 2.2  AI 2.3  AI 3.1 | 4 | 5 | QS | Lab 111 |
| 6 | **IWSP 3** Consultation on the implementation of IWS4 | LО 1 | AI 1.1 | 1 |  |  | MS Teams |
| 6 | **IWS 4.** A set of problems on complex compounds, solution preparation, mixing, dilution. | LО 4 | AI 4.1  AI 4.2 |  | 10 | IT |  |
| 7 | **L.7** Complex compounds in solution. Complexometric titration. Metal indicators. The method of complexometry to determine the composition of food products. | LО 1 LО 2 | AI 1.1  AI 2.1 | 1 |  |  | MS Teams |
| 7 | **Lab 7** Determination of calcium and magnesium by complexometric methods | LО 2 | AI 2.1 | 4 | 15 | QS | Lab 111 |
| 8 | **L.8** Redox reactions, evaluation of redox ability, Nernst equation. Redox equilibrium constant, influencing factors. | LО 1 LО 2 | AI 1.1  AI 2.1 | 1 |  |  | MS Teams |
| 8 | **Lab 8** Complexometric titration of aluminum by reverse titration. | LО 2 LО 3  LО 4 | AI 2.1-2.3  AI 3.1  AI 4.1-4.2 | 4 | 5 | QS | Lab 111 |
| 8 | **IWSP 4** Consultation on the implementation of IWS5 |  |  |  |  |  |  |
| 8 | **IWS 5** A set of problems for complexometric calculations, performed in the process of redox titration. |  |  |  | 10 | IT | MS Teams |
| 9 | **L.9** The place of redox reactions in titrimetric analysis. Nernst equation Ways to determine the final titration point in redox methods. Indicators of redox titration. Methods of permanganatometry, dichromatometry. | LО 1 LО 2 | AI 1.1  AI 2.1 | 1 |  |  | MS Teams |
| 9 | **Lab 9** Determination of iron by dichromatometric method | LО 2 LО 3  LО 4 | AI 2.1-2.3  AI 3.1  AI 4.1-4.2 | 4 | 15 | QS | Lab 111 |
| 9 | **IWSP 5** Control work |  |  |  | 20 |  |  |
| 10 | **L.10** Equilibrium constants in heterogeneous systems. Solubility product. Solubility. Gravimetric method of analysis, characteristics, types, conditions of sedimentation. Stages of the gravimetric method. | LО 1 LО 2 | AI 1.1  AI 2.3 | 1 |  |  | MS Teams |
| 10 | **Lab 10** Determination of copper by iodometric method  Determination of milk sugar by iodometric method in regular and dry milk  Colloquium | LО 2 LО 3  LО 4 | AI 2.1-2.3  AI 3.1  AI 4.1-4.2 | 4 | 25 | QS | Lab 111 |
| 10 | **MT** |  |  |  | 100 |  |  |
| **Module 2. Physico-chemical methods of analysis** | | | | | | | |
| 11 | **L.11** Classification of physicochemical methods. Methods of optical spectroscopy, their classification. | LО 1 | AI 1.1  AI 2.2 | 1 |  |  | MS Teams |
| 11 | **Lab 11** Determination of iron by gravimetric method. Carrying out calculations | LО 2 LО 3  LО 4  LO 5 | AI 2.1-2.3  AI 3.1  AI 4.1-4.2  AI 5.1-5.2 | 4 | 15 | QS | Lab 111 |
| 12 | **L.12** Methods of photometric analysis. Bouguer-Lambert-Behr law. Methods for calculating the concentration by analytical signal. | LО 1 LО 2 | AI 1.1  AI 2.2 | 1 |  |  | MS Teams |
| 12 | **Lab 12** Introduction to the construction of photocolorimeters. Comparison of types, features, areas of application of photometric analysis (colorimetry, photocolorimetry and spectrophotometry; IR). Determination of unknown solution concentration | LО 2 LО 3  LО 4  LO 5 | AI 2.1-2.3  AI 3.1  AI 4.1-4.2  AI 5.1-5.2 | 4 | 5 | QS | Lab 111 |
| 12 | **IWS 6** Problems on spectroscopy. |  |  |  | 10 | IT | - |
| 13 | **L.13** Electrochemical methods of analysis. Potentiometry. | LО 1 LО 2 | AI 1.1  AI 2.4 | 1 |  |  | MS Teams |
| 13 | **Lab 13** Photometric determination of β-carotene in juices, fruits and vegetables. | LО 2 LО 3  LО 4  LO 5 | AI 2.1-2.3  AI 3.1  AI 4.1-4.2  AI 5.1-5.2 | 4 | 5 | QS | Lab 111 |
| 13 | **IWSP 6** Consultation on the implementation of IWS7 |  |  |  |  |  | MS Teams |
| 13 | **IWS 7** A set of problems for the methods of electrochemical determination |  |  |  | 10 |  |  |
| 14 | **L.14** Electrochemical method of analysis - Conductometry. Culonometry | LО 1  LО 3 | AI 1.1  AI 1.2  AI 3.1  AI 3.2 | 1 |  |  | MS Teams |
| 14 | **Lab 14** Potentiometric determination of nitrates in food samples | LО 2 LО 3  LО 4  LO 5 | AI 2.1-2.3  AI 3.1  AI 4.1-4.2  AI 5.1-5.2 | 4 | 15 | QS | Lab 111 |
| 14 | **IWSP 7** Control work |  |  |  | 20 |  | MS Teams |
| 15 | **L.15** Chromatography, method classification. Basic theory, chromatographic parameters. High performance liquid chromatography | LО 1  LО 3 | AI 1.1  AI 1.2  AI 3.1  AI 3.2 | 1 |  |  | MS Teams |
| 15 | **Lab 15** Determination of buffer capacity of milk and cheese by potentiometric titration. Colloquium | LО 2 LО 3  LО 4  LO 5 | AI 2.1-2.3  AI 3.1  AI 4.1-4.2  AI 5.1-5.2 | 4 | 20 | QS | Lab 111 |
| 15 | **FC 2** |  |  |  | 100 |  |  |

[Abbreviations: QS - questions for self-examination; TK - typical tasks; IT - individual tasks; CW - control work; MT – midterm; FC - frontier control.

Comments:

- Form of L and PT: webinar in MS Teams / Zoom (presentation of video materials for 10-15 minutes, then its discussion / consolidation in the form of a discussion / problem solving / ...)

- Form of carrying out the CW: webinar (at the end of the course, the students pass screenshots of the work to the monitor, he/she sends them to the teacher) / test in the Moodle DLS.

- All course materials (L, QS, TK, IT, etc.) see here (see Literature and Resources, p. 6).

- Tasks for the next week open after each deadline.

- CW assignments are given by the teacher at the beginning of the webinar.]

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