**SYLLABUS**

**Fall semester 2022-2023 academic years**

**on the educational program “6B05301 – Chemistry (NIS)”**

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| **Discipline’s code** | **Discipline’s title** | **Independent work of students (IWS)** | **Number of credits** | | | | | **Number of credits** | **Independent work of student with teacher (IWST)** |
| **Lectures (L)** | **Practical training (PT)** | | **Laboratory (Lab)** | |
| MS3219 | Metrology and standardization | 82 | 15 | 15 | | 60 | | 6 | 8 |
| **Academic course information** | | | | | | | | | |
| **Form of education** | **Type of course** | **Types of lectures** | | | **Types of practical training** | | **Form of final control** | | |
| Full-time | Theoretically problematic, | Analytical lecture | | | Problem solving,  situational tasks | |
| Lecturer | Supiyeva Zhazira | | | | | | Written/offline | | |
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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) |
| To improve the quality of the manufactured product, to fulfill the requirements and regulations of the established standards, to obtain a certificate of conformity confirming the quality, and to train specialists who are capable of providing the production site with the latest metrological equipment and their measurement units. | 1. Legal and organizational during metrology, standardization and product certification - methodological bases, measurement theories and measurement methods and knowledge of measurement errors, technical, mathematical, methodological and metrological support of tests, technical regulatory regulations, ISO, MEK standards. | 1.1. know the tasks, basic concepts and definitions of metrology;  1.2. consideration of measurement objects, physical quantities and their measurement units, SI system;  1.3. application of theoretical bases of processing of direct and indirect measurement results;  1.4. determination of methods and means of ensuring the uniformity of measurements;  1.5. to know standardization forms, functions, methods, types of standards;  1.6. general technical systems of the standard, standardization services and organizations, determination of tasks of technical regulation. |
| 2. Calculating errors of measurement results, choosing methods for calibrating measuring instruments, calculating the accuracy of measuring techniques, controlling product quality and monitoring metrological assurance of products and technological processes - makes decisions by using measuring instruments. | 2.1. alignment of measurement errors, standardization of measuring instruments according to metrological characteristics;  2.2. application of laws of distribution of random variables, dispersion, mathematical treatment;  2.3. conceptualization of the distribution laws of Student, Fisher, Pearson. |
| 3. Provide units of measurement, select measuring instruments and measuring tools, use modern means of measurement and control, and perform specific tasks. | 3.1. determination of control methods in the field of production at all stages of production of product quality;  3.2. learning to check measuring instruments based on the calculation of errors in qualitative and quantitative measurements;  3.3. ability to use modern measuring tools and testing equipment. |
| 4. It formulates the skills and methods of performing metrological examination of technological documentation, the structure and components of metrological provision, system problems of metrological provision and ways to solve them. | 4.1. ability to use scientific and technical documentation for measurement tools and methods;  4.2. offer possibilities for experiment planning;  4.3. analysis of the theory of errors in processing the results of chemical measurements. |
| 5. Able to independently analyze the errors of the results obtained during the experiment and establish the optimal standards of measurement accuracy and control reliability. | 5.1. improvement of metrological supply and quality control using modern methods and tools;  5.2. presentation of measurable and controllable parameters of technological processes;  5.3. standardization of metrological characteristics, mastering of checking and calibration of measuring instruments. |
| **Prerequisites** | Physics, parts1,2; Physical Chemistry, parts 1,2; Analytical Chemistry, parts 1,2. | |
| **Post requisites** | Physical methods of research, Diploma practice | |
| **Information resources** | **Literature:**  1. Elisabeth Mansfield, Debra L. Kaiser, Daisuke Fujita, Marcel Van de Voorde. Wiley-VCH Metrology and Standardization for Nanotechnology: Protocols and Industrial Innovations (Applications of Nanotechnology) / 1st edition (April 10, 2017). - 626 p.  2. R.K. Rajput Measurements & Metrology /S.K. Kataria & Sons. - 310 p.  3. Bureau International des Poids et Mesures (BIPM). International vocabulary of metrology—basic and general concepts and associated terms (VIM). 3rd ed. 2008 version with minor corrections; 2008. Available at https://www.bipm.org/en/publications/guides/.  4. Сыздыкова Л.И. Метрология, стандартизация и сертификация: Программа, тестовые вопросы, задачи: Учебное пособие. - Алматы: Қазақ университеті, 2008. – 120 c.  **Internet resources:**  1. <http://elibrary.kaznu.kz/ru>  2. <https://metrob.ru/html/literatura.html> | |

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| **Academic policy of the course in the context of university moral and ethical values** | **Academic Behavior Rules:**  All students are required to register for the MOOC. The deadlines for completing the modules of the online course must be strictly observed in accordance with the schedule for studying the discipline. Leave in case of current MOOC or SPOC courses.  **ATTENTION!** Failure to meet deadlines results in loss of points! The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the training course, as well as in the MOOC. Leave in case of current MOOC or SPOC courses.  **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 Supiyeva.Zhazira@kaznu.kz. |
| **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:**

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| Week | Topic name | Number of hours | Max.  score |
| **Module 1**  Theory of metrology, measuring instruments | | | |
| 1 | **Lec 1.** Introduction. Brief history and current state of metrology system development in the Republic of Kazakhstan. | 1 |  |
| 1 | **Sem 1.** Type of measurement, units of physical quantities. | 1 | 10 |
| 2 | **Lec 2.** Basic concepts and definitions of metrology. Metrology as a science. Measuring tools used in the workplace. Metrological maintenance of production. The metrological characteristics of measuring tools. Regulatory documents for measuring tools. | 1 |  |
| 2 | **Sem 2.** Classification of measuring instruments. Static and dynamic characteristics. | 1 | 10 |
| 2 | **IWST 1.** Consultation on the implementation of the IWS 1 on the topic: «Metrological aspects of chemical analysis». | 1 |  |
| 3 | **Lec 3.** Metrology and provision of metrological measurement units. | 1 |  |
| 3 | **Sem 3.** Standardization of metrological characteristics of measuring instruments. Mini test on lecture No. 1-2. | 1 | 10 |
| 3 | **IWS 1.** Completion of the IWS 1 on the topic: «Metrological aspects of chemical analysis». | 1 | 20 |
| 4 | **Lec 4.** Measurement methods and types. | 1 |  |
| 4 | **Sem 4.** The concept of error. Classification. | 1 | 10 |
|  | **IWST 2.** Consultation on the implementation of the lecture materials. | 1 |  |
| 5 | **Lec 5.** Uniformity of measuring instruments and testing of measuring instruments. | 1 |  |
| 5 | **Sem 5.** Comparison of measuring instruments. Colloquium on lectures 1-4. | 1 | 10 |
| **Module 2**  Metrological organizations, standardization bases | | | |
| 6 | **Lec 6.** Conduct metrological certification of state metrological supervision, control and measuring instruments. | 1 |  |
| 6 | **Sem 6.** Benchmarks and verification schemes. 1-5 mini control of the lecture. | 1 | 10 |
| 7 | **Lec 7.** Estimation of distribution parameters. Confidence Interval and Confidence Probability. St’udent method. | 1 |  |
| 7 | **Sem 7.** Determination of measured quantity, variance and mean square deviation. | 1 | 20 |
| 7 | **IWST 3.** Consultation on the implementation of the IWS 2 on the topic: «Calculate Errors in Measurement» | 1 |  |
|  | **LEVEL CONTROL 1** |  | **100** |
| 8 | **Lec 8.** Three purposes of error theory. | 1 |  |
| 8 | **Sem 8.** Determining indirect measurement error. Mini control. | 1 | 5 |
| 8 | **IWS 2.** Completion of the IWS 2 on the topic: «Calculate Errors in Measurement» | 1 | 10 |
| 9 | **Lec 9.** A general description of standardization. Scientific and methodological bases of standardization. Purposes, principles and functions of standardization. Regulation of standardization subjects. General concept of standardization methods. | 1 |  |
| 9 | **Sem 9.** Application of international standards of the Republic of Kazakhstan. Legal framework of the State system for technical regulation. Regulatory documents on the standardization used in the territory of RK. The law of the Republic of Kazakhstan "On technical regulation". | 1 | 5 |
| 10 | **Lec 10** General characteristic of standards of different categories and types. The stages of the standards development. Structural elements and the examination of standards. | 1 |  |
| 10 | **Sem 10.** Product quality assurance standard. Colloquium on lectures 6-10. | 1 | 10 |
| 10 | **IWST 4.** Consultation on the implementation of the IWS 3 on the topic: «Types of standards depending on the characteristics of the chemical object» | 1 |  |
|  | **Module 3**  Standardization organizations, activities |  |  |
| 11 | **Lec 11** Standardization organizations, activities. | 1 |  |
| 11 | **Sem 11.** Use of regulatory documents in the area of standardization. | 1 | 10 |
| 12 | **Lec 12** Classification and coding of state information, procedure for use. Product data sheets. Product barcoding. Examination of the product data sheets. | 1 |  |
| 12 | **Sem 12.** Commodity coding system, bar code. | 1 | 10 |
| 12 | **IWST 5.** Completion of the IWS 3 on the topic: «Types of standards depending on the characteristics of the chemical object» | 1 | 10 |
| 13 | **Lec 13** Service standardization. | 1 |  |
| 13 | **Sem 13.** Basic principles and objects of service standardization. Mini control. | 1 | 10 |
| 13 | **IWS 3.** Consultation on the implementation of the IWS 4 on the topic: «Assessment of metrological reliability of measuring instruments and multi-valued quantities» | 1 |  |
| 14 | **Lec 14** International standardization. The forms and objects of state control; the composition of the Commission, making state control; the inspection order; the assessment of the correctness of the MI metrological control. | 1 |  |
| 14 | **Sem 14.** ISO International Organization Executive System Services. The forms and objects of state control; the composition of the Commission, making state control; the inspection order; the assessment of the correctness of the MI metrological control. | 1 | 10 |
|  | **IWST 6.** Completion of the IWS 4 on the topic: «Assessment of metrological reliability of measuring instruments and multi-valued quantities» | 1 | 10 |
| 15 | **Lec 15** Status of certification development and main directions of development, principles of accreditation. The history of the certification development; Documenting of the conformity attestation procedures; Basic guidelines on conformity assessment; Declaration of conformity; Certification and regulatory principles in the field of conformity assessment; Authorized agency in the field of conformity assessment. | 1 |  |
| 15 | **Sem 15.** Certification system. Accreditation documents. Submission of colloquium (11-15 lectures) (written-oral) | 1 | 10 |
| 15 | **IWST 7.** Consultation on examination issues | 1 |  |
|  | **LEVEL CONTROL 2** |  | **100** |

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