The syllabus for discipline «BASICS OF CHEMICAL METROLOGY»

1. General information	
Name ot the faculty	pharmaceutical faculty
Educational program	22 Health, 226 Pharmacy, industrial pharmacy, Second (master's) educational level, full-time course
Навчальний рік	2021-2021
Course title, code	Basics of chemical metrology, OK35,
Department (*address, phone, e-mail*)	Department of toxicological and analytical chemistry 79010, Lviv, Pekarska str., 69 +38 (032) 368437 kaf_toxchemistry@meduniv.lviv.ua
Head of department *(e-mail)*	Halkevych Irine, PhD, Associated professor, galkirin@meduniv.lviv.ua
Year of study	2nd year
Semester	III, VI semester
Type of discipline	Elective
Викладачі	1. Bidnychenko Yuriy, PhD, Associated professor; bidnyuri@i.ua 2. Davydovych Sofia, PhD, Assistant professor, ihlitska.sophia@gmail.com 3. Kramarenko Serhiy, PhD, Senior Lecturer, sergeikr@gmail.com
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Total credits ECTS	2.0 credits
Total number of hours	60 h (Lectures – 10 / Practical classes – 10 / ISW – 40)
Language	English
Інформація про консультації	Consultations at the department take place in accordance with the approved schedule of consultations
2. Course description (abstract)	
"Basics of the chemical metrology" is intended for students of higher education institutions of the pharmaceutical profile of Ukraine and is an integral part of the state standard of education. This is a discipline for methods of mathematical processing of chemical analysis results. In the working program of basics of the chemical metrology included the modern mathematics methods for qualitative and quantitative analysis, and chemometrics. According to the syllabus, discipline «Basics of the chemical metrology" is studied in the second year in the 3th and 4th semesters.	

The subjects of the discipline are the theoretical basis of chemical metrology and statistical analysis of the results of the chemical experiments in accordance with the requirements of State Pharmacopoeia of Ukraine 2.0.

3. Goals and objectives of the course

1. The purpose of the «Basics of chemical metrology» course is to provide students with the necessary knowledge and, based on modern scientific ideas, to form the necessary theoretical knowledge in the field of forensic and toxicological chemistry. As well as the formation of students' chemical-expert thinking and development of skills and methods of methods of isolation of poisons from objects of biological origin, as well as the identification and determination of xenobiotics and their metabolites in carrying out chemical-toxicological or forensic toxicological studies.

2. The main tasks of studying the discipline "Basics of chemical metrology" are:

- formation of students 'knowledge and skills, practical skills from the basics of chemical metrology, which is the discipline of choice in the system of preparation of the pharmacist;
- preparation of students for a better study of special pharmaceutical disciplines: pharmaceutical chemistry, pharmacy and factory technology of medicines, pharmacognosy, toxicological chemistry, etc.

3. Competencies and learning outcomes, the formation of of which is facilitated by discipline (the relationship with the normative content of the training of higher education graduates, formulated in terms of results of study in the Standard of Higher Education).

According to the requirements of the Standard discipline "Basics of chemical metrology" contributes to the acquisition of students competencies:

integral:

- ability to solve typical and complex specialized problems and practical problems in professional pharmaceutical activity, applying the theoretical principles of the basics of chemical processes and methods of chemical and physical-chemical analysis (qualitative and quantitative) that involves conducting experimental research, introducing innovative methods of analysis, to reasonably justify the results of definitions and to unambiguously communicate their findings and knowledge to the professional and non-physical audience; general:
- ability to apply knowledge in practical situations
- knowledge and understanding of the subject area and understanding of the profession;
- ability to abstract thinking, analysis and synthesis, ability to learn and master modern knowledge;
- skills of using information and communication technologies;
- the ability to evaluate and ensure the quality of performed work;
- ability to conduct research at the appropriate level;
- striving to preserve the environment;

with special (specialty, subject) :

- ability to organize, provide and perform the analysis of the quality of medicinal products in pharmacy and pharmacy control and analytical laboratories in accordance with the State Pharmacopoeia and other regulatory acts;
- ability to test, biopharmaceutical research and methods of drug control;
- ability to determine the list of equipment and reagents for the quality control of medicinal products in accordance with the requirements of the State Pharmacological Center and other regulatory documents;
- ability to prepare reagents for the analysis of drugs using chemical and physical-chemical methods;
- ability to develop methods for controlling the quality of medicinal products, pharmaceutical substances, medicinal plant raw materials and auxiliary substances using physical, physical, chemical and chemical methods of control;
- ability to interpret and evaluate the results of the analysis of medicinal products.

Detailing competencies according to the NRC descriptors in the form of the Competence Matrix.

4. Course prerequisites		
"Basics of chemical metrology" as a discipline that is based on the knowledge, skills and knowledge acquired by students in the study of previous disciplines: • mathematics, physics and analytical chemistry; • establishes the basis for the study of pharmaceutical and toxicological chemistry and involves the formation of skills for the use of the knowledge acquired for the study of special disciplines and professional activities.		
5. Programm learning outcomes		
List of learning outcomes		
Code of learning outcomes	**Content of learning outcomes**	**Link to the code in the Competence Matrix**
Knowledge – Kn., Skill – Sk., Communication – C., Autonomy and responsibility – AR.		
General competencies		
Kn-1	Have specialized conceptual knowledge acquired in the learning process.	*ПР-2. Ability to apply knowledge in practical situations*
Sk-1	Be able to solve complex problems and problems that arise in professional activity.	
C-1	Clear and unambiguous communication of their own conclusions, knowledge and explanations, which substantiate them to specialists and non-specialists.	
AR-1	Responsible for acceptance decisions in difficult conditions	
Kn-2	Have deep knowledge of structure professional activity.	*ПР-6. Knowledge and understanding of the subject area and understanding of the profession*
Sk-2	Be able engage in professional activities that require updating and integration of knowledge.	
C-2	Ability to effectively shape communication strategy in professional activities.	
AR-2	Be responsible for professional development, the ability to further vocational training with a high level of autonomy.	
Kn-3	Know the methods of analysis, synthesis and further modern learning.	*ПР-4. Ability to abstract thinking, analyzing and synthesizing, being able to learn and be modern in learning.*
Sk-3	Be able to analyze information, make informed decisions, and be able to acquire modern knowledge.	
C-3	Establish appropriate links to achieve goals.	
AR-3	Be responsible for the timely acquisition of modern knowledge.	
Kn-4	Have deep knowledge in the field of information and communication technologies used in professional activity	*ПР-9. Use of information and communication technologies*
Sk-4	Be able to use information and communication technologies in the professional field that requires updating and integration of knowledge	
C-4	To use information and communication technologies in professional activity	
AR-4	Be responsible for the development of professional	

	knowledge and skills	
Kn-5	Know the methods of evaluating performance indicators	*ПР-11. Ability to evaluate and ensure the quality of work performed*
Sk-5	Be able to provide quality work	
C-5	Establish links to ensure the quality of work	
AR-5	Be responsible for quality work	
Kn-6	Know the components of the health care system, plan and evaluate research	*ПР-12. Ability to conduct research at an appropriate level;*
Sk-6	Search for scientific sources of information; to choose the methods of scientific research, to use the methods of mathematical analysis and modeling, theoretical and experimental research in pharmacy	
C-6	Use information from scientific sources	
AR-6	Be responsible for the development and implementation of planned projects	
Kn-7	Know the problems of environmental conservation and how to conserve it	*ПР-3. The desire to preserve the environment*
Sk-7	Be able to formulate requirements for yourself and others for environmental protection	
C-7	Make proposals to the relevant authorities and agencies on conservation and environmental protection measures	
AR-7	Be responsible for the implementation of environmental measures within its competence	
Special (specialized, subject) competences		
Kn-8	Know the modern requirements for organizing and ensuring quality control of medicines in the pharmacy and pharmacy business.	*ПР-__. Ability to organize, provide and perform an analysis of the quality of medicinal products in pharmacy and pharmacy control and analytical laboratories in accordance with the requirements of the State Pharmacopoeia and other regulatory acts.*
Sk-8	Be able to choose chemical and physical-chemical methods for analyzing the quality of medicinal products.	
C-8	To substantiate the methods of analysis of pharmaceutical products in a pharmacy and pharmaceutical company.	
AR-8	To be responsible for the quality control of drugs in a pharmacy and pharmacy.	
Kn-9	Know the chemical and instrumental methods of analysis.	*ПР-__. Ability to test, biopharmaceutical research and drug control methods.*
Sk-9	To be able to apply chemical and instrumental methods of analysis, conduct biopharmaceutical research for the control of medicinal products.	
C-9	To be able to apply chemical and instrumental methods of analysis, conduct biopharmaceutical research for the control of medicinal products.	
AR-9	Be responsible for the decision on the evaluation results of chemical, physico-chemical and biopharmaceutical control	

	methods of medicines.	
Kn-10	Know the requirements of the State Pharmacopoeia and other normative documents.	*ПР-14. Ability to determine the list of equipment and reagents for the organization of quality control of medicinal products in accordance with the requirements of the State Pharmacopoeia and other normative documents.*
Sk-10	Be able to prepare the necessary reagents and work with modern equipment of chemical laboratories.	
C-10	Provide lab work as required State Pharmacopoeia and other regulations.	
AR-10	Responsible for organizing the quality control of medicines accordance with State Pharmacopoeia and other normative document.	
Kn-11	Know the chemical and advanced instrumental methods of analysis; know the specificity and sensitivity of different research methods.	*ПР-32. Ability to prepare reagents for the analysis of drugs using chemical and physicochemical methods.*
Sk-11	Be able to choose the methods of research of medicinal products and prepare reagents for analysis.	
C-11	Argument selection of analysis methods.	
AR-11	Be responsible for the results of analysis of drugs.	
Kn-12	Know: - qualitative analysis of cations and anions; - medicinal substances of inorganic nature; - general methods of analysis of inorganic and organic drug compounds; - chemical titrimetric methods of analysis; - chromaticographic methods of identification and quantification of substances; - the distribution of light in matter, methods of luminescent analysis; - optical activity and specific rotation; - gravimetric method of analysis; - the main concepts of the titrimetric analysis; - spectral analysis methods.	*Ability to develop methods of dugs assay, pharmaceutical substances, and auxiliary substances using physical, physical, chemical, and chemical methods of control.*
Sk-12	Be able to prepare titrated, working solutions and solutions of indicators for chemical reagents and to establish the percentage concentration and molarity of titrimetric and physico-chemical methods.	
C-12	To develop methods of quality control of pharmaceutical products.	
AR-12	Be responsible for the validity of developed quality control methods.	
Kn-13	Know the standard statistical analysis procedures.	*Ability to interpret and evaluate the results of the analysis of drugs.*
Sk-13	Be able to substantiate the size of the sample, apply static analysis methods, and give results of statistical data processing.	
C-13	To evaluate the quantification results reasonable.	

AR-13	Be responsible for conducting analysis and obtaining reliable and reproducible results.	

6. The course format

The format of the course	Full-time course		
Type of classes	The total number of hours	The number of hours in 3 semester	The number of hours in 4 semester
Lectures	10	6	4
Practical classes	10	6	4
Self-study	40	20	20

7. Topics and content of the course

Type of classes	Theme	Code of learning outcomes
L-1	Chemical metrology as a science. Subject of chemical metrology, purpose, tasks, methods. Types of quantities. Chemical experiment, as a metrological procedure, its features. Metrological characteristics of the analysis: sensitivity, minimum (limit) concentration, limiting dilution.	Kn-1 – Kn-15; Sk-1 – Sk-15; C-1 – C-15; AR-1 – AR-11.
L-2	The notion of error and uncertainty of measurement. Errors in chemical analysis, their classification and causes of occurrence. Methods of finding and eliminating systematic errors. Means of measurement, their main characteristics and methods of checking their accuracy.	Kn-1 – Kn-15; Sk-1 – Sk-15; C-1 – C-15; AR-1 – AR-11.
L-3	Basic concepts, subject and tasks of mathematical statistics. Random errors of chemical analysis. General and sample aggregate. Functions and laws of the distribution of random variables, their relation to random errors of chemical analysis. Normal distribution law. Reasons for rejecting results from the normal distribution law. Use of statistical analysis to process the results of a chemical experiment in accordance with the State Pharmacopoeia 2.0. Trust intervals and estimation of their magnitude. Methods of comparing the results of the analysis.	
L-4	Dispersion analysis. His criteria and tasks. Fundamentals of regression analysis. The concept of a regression model, evaluation of its characteristics.	
L-5	Chemometrics, Goal and Tasks. Ways of using computers in analytical chemistry. Calculation and statistical estimation of parameters of linear dependence. Correlation analysis. Estimation of the correlation coefficient.	

Type of classes	Theme	Content	Code of learning outcomes
P-1	*Metrological characteristics of the analysis: sensitivity, minimum (limit) concentration, limiting dilution.*	General and sample aggregate. The method of sampling in chemical research. Results of chemical analysis as random variables. Statistical processing of the results of chemical analysis according to the State Pharmacopoeia	

		2.0.	
P-2	*Errors in chemical analysis, their classification and causes of occurrence. Methods of finding and eliminating systematic errors.*	Systematic errors that may occur during research. Failures as gross analysis errors. Methods of checking the results of the study on failures. Statistical processing of the results of a chemical analysis containing failures.	
P-3	*Methods of comparing the results of the analysis.*	Using Student's and Fisher's criteria to compare the results of the analysis. Use of these criteria in chemical analysis.	
P-4	*Fundamentals of regression analysis.*	The main ideas of correlation and regression analysis. The estimation of the relationship between two features using correlation analysis and the construction of the regression equation using the least squares method.	
P-5	*Ways of using computers in analytical chemistry.*	The concept of validation of analytical techniques. The order of its conducting. Conducting calculation of values that are not necessary for validation of the analytical technique in accordance with the State Pharmacopoeia 2.0.	
ISW-1	Classification of errors: absolute and relative, constant and proportional; Error of unit measurement, average; method errors, generalized error; errors are direct and indirect. Ways to minimize errors.		
ISW-2	Systematic errors in chemical analysis. Three types of systematic error, constant and proportional systematic errors. Methods of their determination. Instrumental errors (techniques for minimizing instrumental errors - randomization and relationalization) reactive (classes of purity of reagents), methodical, their interpretation.		
ISW-3	Basic types of statistical data. Means of measurement, their classes of accuracy. The main measurement scales, their characteristics.		
ISW-4	Planning a chemical experiment and filtering data. Peculiarities of the application of methods of experiment planning in the study of complex chemical objects.		
ISW-5	Reproducibility of the result of chemical analysis. Methods for determining reproducibility. Criteria for Bartlett, Fisher, Cochran.		
ISW-6	Theory of errors and their use for processing the results of chemical analysis. Distribution of mistakes in calculations.		
ISW-7	Theory of pattern recognition. Fundamentals of cluster and discriminatory analysis.		
ISW-8	International metrological organizations and their main tasks and functions. International and national standards of physical quantities. Transmission of information on unit size from the reference to measuring instruments.		

ISW-9	Systems of units. Principles of dimensional systems construction. International system of units SI. Systems that existed before SI. Units not included in SI, but widely used.	

Learning methods

Explanatory-illustrative, problematic presentation, partially-exploratory.

Studying Basics of chemical metrology students use textbooks, lecture notes, methodological guidelines, chemical computer software, molecular models, laboratory devices and glassware necessary for performing experiments.

Methods for organization and accomplishment of studies are:

a) lectures
b) practical classes
c) students' independent study.

The topics of the lecture course cover the problematic issues of the appropriate sections of toxicological and forensic chemistry.

Practical classes are organized as laboratory classes. These classes include: laboratory studies on detection of specific classes of toxic compounds according to their functional groups, performing specific reactions. Students are recommended to write short-term protocols of laboratory studies, indicating the purpose of the study and the conclusions.

The structure of practical classes includes:

- Discussion and explanation of the most complicated issues of the topic;
- Written test;
- Practical (laboratory) work.
- Filling in a practical lesson protocol.
- Summary of the lesson.

The student's self-study material, which is provided in the subject of the practical lesson at the same time as the classroom work, is evaluated during the ongoing control of the topic in the relevant practical lesson.

Assessment of topics that are presented for self-study and not included in the topics of classroom training, are controlled during the final (credit) classes and exam.

Methodological support. The list and content of educational and methodological support for the study of the discipline "Basics of chemical metrology" includes:

- synopsis or extended lesson plan;
- thematic plans of lectures, practical classes, independent work of students;
- tasks for laboratory work and independent work of students;
- questions, tasks, tasks for current and final control of students' knowledge and skills, complex control work, post-certification monitoring of acquired knowledge and skills in the discipline.

8. Verification of learning outcomes

Current control

Types of control: current (routine) and final. ***Form of final control in accordance with the curriculum:*** a credit (4 semester).

Control of knowledge and level of students' mastering theoretical material, independent work and the level of acquired skills and practical skills is carried out in practical classes by oral questioning of students; by means of test, graphic and written control; solving situational problems; by evaluating the practical experimental work performed, by assessing the student's ability to correctly interpret the research results obtained, and by evaluating the laboratory protocols drawn up.

At each practical session, the student answers standard questions from the material of the current topic of the lesson, the questions of the lecture course and independent work that relate to the current lesson. The student demonstrates knowledge and skills of practical skills in accordance with the topic of the practical lesson.

It is recommended to apply objective (standardized) kind of control to check theoretical and practical knowledge of students.

The standardized control of the theoretical part includes 13 tasks. Ten of them are the first level test questions. Another three are referred to the tasks of the second level and required a written response (reaction schemes, structure formulas etc.) on the topic of the practical lesson, knowledge of which is necessary for understanding the current topic, questions of the lecture course and independent work related to the current lesson, demonstrates knowledge and skills of practical skills in accordance with the topic of the practical lesson.

Criteria of assessment of current educational activity:

"Excellent" mark receives a student who correctly, clearly, logically and completely answered the standardized questions of the current topic, including the questions of the lecture course and independent work, gave at least 90% of correct answers to standardized tests, responded to written tasks without any mistake, performed practical work and filled in the protocol.

"Good" mark gets a student who answered the standardized questions of the current topic, lecture course and independent work, gave at least 70% of correct answers to standardized tests, responded to written tasks with some insignificant mistakes, performed practical work and filled in the protocol.

"Satisfactory" mark receives a student who gave with additional questions incomplete answer, could not independently build a clear, logical answer; gave at least 50% of correct answers to standardized tests, responded to written tasks with a lot of mistakes, made mistakes while demonstrating practical skills but performed practical work and made the protocol.

"Unsatisfactory" mark receives a student who cannot answer on question on the current topic with additional questions, cannot construct a logical answer, did not understand the content of the material; gave less than 50% of correct answers to standardized tests, responded to written tasks with gross mistakes or did not give answer, didn't perform practical work and didn't make the protocol.

The total score for the current achievement is the arithmetic mean (CA) of the sum of the scores for the test control and the answers to the questions.

Only those students who completed all types of works provided by syllabus and during study scored points not less than the minimum (3,0), and don't have any undone lectures and practical classes are allowed to put the exam. The standardized form of the exam includes control of theoretical and practical knowledge.

Code of learning outcomes	Type of classes	Verification of learning outcomes	Enrollment criteria
Kn-1 – Kn-15; Sk-1 – Sk-15; C-1 – C-15; AR-1 – AR-15.	P-1–P-35 ISW-1–ISW-33	Current control: • oral control over the topic of the lesson, standardized questions, knowledge of which is necessary to understand the current topic, questions of the lecture course that relate to the current lesson; • written test control, • solving situational problems, • conducting laboratory tests, • interpretation and evaluation of laboratory test results, • report on the performed laboratory work.	Assessment according to established criteria (see above) with 4-point (national) scale. To enroll in the discipline, it is necessary to confirm the achievement of each learning outcome.
Kn-1 – Kn-15; Sk-1 – Sk-15; C-1 – C-15; AR-1 – AR-15.	ISW-1–ISW-33	• Oral control in the form of a survey in accordance with the subject of independent work. • Test control on the subject of independent work.	Enrolled / not enrolled
The Final control			
General evaluation system	**The final control** is carried out upon completion of the study of the discipline Toxicological and Forensic Chemistry in the form of a credit (4 semester). Final control is allowed for students who have completed all types of work required by the curriculum, have completed all training sessions, and have earned points above the minimum level when studying the module. Participation in the work during the semester - 100% on a 200-point scale		
Grades	4-point (national) scale, a multi-scale (200-point) scale, ECTS success scale		
Conditions of admission to the final control	Students who have completed all types of work required by the curriculum, have completed all training sessions, and have earned points above the 120 points when studying the course.		
Form of final control	The form of final control of the success of studies in the study of "Basics of chemical metrology" in the 4th semester is **a credit**.		Evaluation criteria
A credit	Each class assesses students' knowledge on a 4-point (national) scale. This takes into account all types of work provided by the discipline program. The assessment of basics of chemical metrology in the 4th semester is based on the results of the current		*The maximum number of points - 200.* *The minimum number of points - 120*

	educational activity and is expressed on a two-point scale "**enrolled**" or "**not enrolled**". The student receives a grade on each topic to further convert the grades into scores on a multi-scale (200-point) scale.	

Credit Regulations

The form of final control is standardized and includes control of theoretical and practical training.

"Excellent" – A student correctly, clearly, logically and fully responds to standardized issues of the current topic, including issues of independent work. Closely connects the theory with practice and correctly demonstrates the fulfillment (knowledge) of practical skills. Freely solves situational problems of increased complexity, is able to generalize the material.

"Good" – A student correctly and in essence answers standardized questions of the current topic, independent work. Demonstrates performance (knowledge) of practical skills. Correctly uses theoretical knowledge in solving practical problems. Is able to solve light and medium complexity situational tasks. Have the necessary practical skills and methods of their implementation in an amount that exceeds the required minimum.

"Satisfactory" – A student is incomplete, with additional questions, responsible for standardized issues of the current topic, lecture course and independent work. Cannot independently build a clear, logical answer. When answering and demonstrating practical skills, the student makes mistakes. Student solves only the easiest tasks, has only a minimum of research methods.

"***Unsatisfactory"*** – A student does not know the material of the current topic, cannot construct a logical answer, does not answer additional questions, does not understand the content of the material. During the response and demonstration of practical skills makes significant, gross mistakes.

The maximum number of points that a student can get for current educational activity during study is 200 points.

The minimum number of points that a student must get to pass the test on the discipline is 120 points.

Calculating the number of points made on the basis of the student's scores on the traditional 4-point scale during the study of the discipline, by calculating the arithmetic mean (CA), rounded to two decimal places. The received value is converted into points by multi-point rate as follows:

[redacted]

The average score for the current activity is converted into a multi-scale scale using the table below:

Recalculation of the average score on "Basics of chemical metrology" for the current activity into a multi-scale scale:

4 point scale	**5**	**4.97**	**4.95**	**4.92**	**4.9**	**4.87**	**4.85**	**4.82**	**4.8**	**4.77**	**4.75**	**4.72**	**4.7**
200 point scale	200	199	198	197	196	195	194	193	192	191	190	189	188
4 point scale	**4.67**	**4.65**	**4.62**	**4.6**	**4.57**	**4.52**	**4.47**	**4.45**	**4.42**	**4.4**	**4.37**	**4.35**	**4.32**
200 point scale	187	186	185	184	183	181	180	178	177	176	175	174	173
4 point scale	**4.3**	**4.27**	**4.24**	**4.22**	**4.19**	**4.17**	**4.14**	**4.12**	**4.09**	**4.07**	**4.04**	**4.02**	**3.99**
200 point scale	172	171	170	169	168	167	166	165	164	163	162	161	160
4 point	**3.97**	**3.94**	**3.92**	**3.89**	**3.87**	**3.84**	**3.82**	**3.79**	**3.77**	**3.74**	**3.72**	**3.7**	**3.67**

scale														
200 point scale	159	158	157	156	155	154	153	152	151	150	149	148	147	
4 point scale	**3.65**	**3.62**	**3.57**	**3.55**	**3.52**	**3.5**	**3.47**	**3.45**	**3.42**	**3.4**	3.**37**	3.**35**	3.**32**	
200 point scale	146	145	143	142	141	140	139	138	137	136	135	134	133	
4 point scale	**3.3**	**3.27**	**3.25**	**3.22**	**3.2**	**3.17**	**3.15**	**3.12**	**3.1**	**3.07**	3.**02**	3	**Less 3**	
200 point scale	132	131	130	129	128	127	126	125	124	123	121	120	Not enough	

The **maximum number of points** that a student can earn for his / her current academic activity upon obtaining a semester credit **in the 4th semester** is 120 points. The minimum number of points that a student must earn for his / her current academic activity in the 4th semester (to receive a semester credit) is 72 points (60% of 120 - maximum points).

Final assessment of the discipline "Basics of chemical metrology".

The points obtained by students in the final assessment of the discipline are converted into the traditional 4-point scale by the absolute criteria, which are given in the table below:

Score from discipline	Score on 4-point rate
From 170 to 200 points	5
From 140 to 169 points	4
From 139 to 120 points	3
Below the minimum number of points which student must get	2

To determine the ECTS score, a ranking is made by the number of points earned by the student in the final assessment of the discipline.

Ranking with assignments of grades "A", "B", "C", "D", "E" is made for students of this course, who study in one specialty and have successfully completed the study of the discipline.

The objectivity of the evaluation of students' educational activity is verified by statistical methods (the correlation coefficient between the ECTS grade and the national scale grade).

Conversion of rating point to **ECTS** success **scale** :

ECTS grade	Statistics	Calculations
A	Top 10%	200 - 110 = 90 points 90 b. × 10% = 9 b.
B	Next 25%	90 b. × 25% = 23 b.
C	Next 30%	90 b. × 30% = 27 b.
D	Next 25%	90 b. × 25% = 23 b.
E	Last 10%	90 b. × 10% = 9 b.
F_x	Resubmission	The gap between "folded - not folded" and the minimum tolerance score
F	Compulsory re-training	Less than the minimum tolerance score

Students who have received grades F_X and F ("unsatisfactory") are not included in the list of students who are ranked. Students with an F_X score automatically receive an "E" grade upon transfer. Upon receipt of the F o rating, it is necessary to undergo a second course of study.

Mark written by ECTS can't be converted into traditional scale because the ECTS scale and 4-point scale are independent (do not coincide).

9. Course policies

Attendance policies outline student requirements for participation, whether in a physical classroom or digital learning experience. These policies will generally outline how often a student must attend a course and the consequences of not fulfilling that obligation.

Students are expected to attend all classes and course activities for which they are registered. Any class meeting missed, regardless of cause, reduces the opportunity of learning and may adversely affect a student's achievement in the course. Students are required to attend at least 90% of the class meetings in order to receive credit for the course. An accurate record of attendance will be kept for each course. If a student misses one- third or more of a class session, the student will be counted absent. Three tardiest will count as one absence. Leaving early is the same as being tardy.

If a student misses a class, it is THEIR responsibility to make up the material missed.

Academic Dishonesty. Adherence to academic integrity by students involves:

1. Independent performance of educational tasks, tasks of current and final control of learning outcomes (for persons with special educational needs this requirement is applied taking into account their individual needs and opportunities);

2. References to sources of information in the case of the use of ideas, developments, statements, information; Compliance with copyright and related rights legislation;

3. Providing reliable information about the results of their own (scientific, creative) activities, used research methods and sources of information.

Violations of academic integrity are: academic plagiarism, self-plagiarism, fabrication, falsification, write-off, deception, bribery, biased evaluation.

For violation of academic integrity, students may be involved in re-assessment.

Personal technology policies focus on the permitted use of technology within the classroom.

Per university policy and classroom etiquette; mobile phones, iPods, etc. must be silenced during all classroom and lab lectures. Those not heeding this rule will be asked to leave the classroom/lab immediately so as to not disrupt the learning environment. Please arrive on time for all class meetings. Students who habitually disturb the class by talking, arriving late, etc., and have been warned may suffer a reduction in their final class grade.

10. Recommended Literature

Compulsory course literature

1. Law of Ukraine "On Metrology and Metrological Activity". (Bulletin of the Verkhovna Rada (BD), 1998, No. 30-31, p.194) (as amended in accordance with the Law No. 762-IV (762-15) of 15.05.2003, VVR, 2003, No . 30 Art. 247)
2. Derffel K. Statistics in Analytical Chemistry. M.: Mir, 1994.
3. Sergeev AG Metrology: Textbook. - M: Logos, 2005. - 272 p.
4. Dvorkin VI Metrology and quality assurance of quantitative chemical analysis. M.: Chemistry, 2001 -263 p.
5. Validation of analytical techniques and tests // State Pharmacopoeia of Ukraine / State Enterprise "Scientific-Expert Pharmacopoeial Center". - 1st kind.- Supplement 2. - Kharkiv: State Enterprise "Scientific Experimental Pharmacopoeia Center", 2008. - P. 85-100.
6. Validation of Analytical Techniques for Drug Producers: Typical Guide for Drug Producers / Edited by VV Beregovyh - Moscow: Litterra, 2008. -132 p.
7. Sharaf MA, Illman DL, Kovalsky BR Chemometrics. - L .: Chemistry, 1989. - 272 p.

Auxiliary literature

1. DSTU ISO \ IEC 17025-2006 General requirements for the competence of testing and calibration laboratories.

2. DSTU 3514-97. Statistical methods of quality control and regulation. Terms and definitions.
3. DSTU ISO 3534-1: 2008 Statistics. Glossary of terms and designations. Part 1. General statistical terms and probability theory terms (ISO 3534-1: 2006, IDT).
4. DSTU ISO 3534-2: 2008 Statistics. Glossary of terms and designations. Part 2. Applied statistics (ISO 3534-2: 2006, IDT).
5. DSTU ISO 3534-3: 2005 Statistics. Glossary of terms and designations. Part 3. Experiment Planning (ISO 3534-3: 1999, IDT).
6. DSTU ISO 9000: 2007 Quality management systems. Basic Terms and Glossary (ISO 9000: 2005, IDT).
7. DSTU ISO 2854-2008 Statistical processing of data. Methods for evaluating and testing hypotheses about mean values and dispersions (ISO 2854: 1976, IDT).
8. DSTU ISO 3301: 2006 Statistical processing of data. Comparison of two mean values obtained in the case of pair observation (ISO 3301: 1975, IDT).
9. DSTU ISO 2602: 2006 Presentation of test results is statistical. Estimation of the average value. Trust interval (ISO 2602: 1980, IDT).
10. Applied statistics. Textbook / AI Orlov. - Moscow: "Examiner" Publishing House, 2004 - 656 pp.

11. Equipment, logistics and software of the discipline / course

Textbooks, computers

12. Additional information

The time and place (specialized, classroom, laboratory, studio, etc.) of the discipline is determined in accordance with the approved schedule. All compulsory and auxiliary literature are available as an e-books.

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