

**Syllabus
educational component**

Metrology

Discipline name:	Metrology
Level of higher education:	Initial (short cycle) of higher education
Course page in Moodle:	https://dl2022.khadi-kh.com/course/view.php?id=3970
The volume of the educational component	3 credits (90 hours)
Form of final control	Passed
Consultations:	on schedule
Name of the department:	Department of Metrology and Life Safety
Language of instruction:	English
Course leader:	Didenko Natalia Viktorivna, Candidate of Technical Sciences, Associate Professor
Contact phone number:	0971808262
Email:	<i>nataly.v.didenko@gmail.com</i>

Summary of the educational component:

The goal is to acquire competence, knowledge, skills and abilities for the implementation of professional activities in the specialty, taking into account modern approaches and methods of measurement and evaluation of errors and uncertainty of measurements, the choice of a set of normalized metrological characteristics of measuring instruments (FTA), methods for calculating, correcting and optimizing FTA errors, methods for processing measurement results.

Subject: theoretical and methodological foundations, methodological provisions of scientific directions of metrology at the present stage.

The main tasks of studying the discipline are:

- substantiation and presentation of common theoretical and methodological foundations of metrology;
- formation of modern system research methods in solving practical intellectual measuring problems in the road construction, transport industries and in mechanical engineering;

Prerequisites for studying the educational component:

Physics; Higher mathematics.

Competences that the applicant acquires:

General competencies:

Ability to apply knowledge in practical situations and justify decisions made.

Ability to search, process and analyze information from various sources.

Knowledge and understanding of the subject area and understanding of professional

activity.

Special (professional) competencies:

The ability to apply knowledge of mathematics, to the extent necessary to use mathematical methods for the analysis and synthesis of automation systems.

Ability to apply knowledge of physics, electrical engineering, electronics and microprocessor technology, to the extent necessary to understand processes in automation systems and computer-integrated technologies.

Ability to apply knowledge of physics, electrical engineering, electronics and microprocessor technology, to the extent necessary to understand processes in automation systems and computer-integrated technologies.

Learning outcomes in accordance with the educational program:

Be able to apply modern information technologies and have the skills to develop algorithms and computer programs using high-level languages and use Internet resources.

Be able to use a variety of specialized software to solve typical engineering problems in the field of automation, in particular, mathematical modeling, computer-aided design, computer graphics methods.

Thematic plan

Topic number	Title of topics (LK, LR, PR, SZ, WED)	Number of hours	
		Eye	Correspondence
1	LC Introduction. The history of the development of metrology. Measured values, their values and units.	2	-
	PR Construction of a histogram according to the measurement results.	2	-
	CP Philosophical aspects of measurements.	6	-
2	LK Ensuring the unity of measurements	2	-
	PR Using the scale of the device to count the measurement result.	2	-
	CP Foreign units of measurement of physical quantities. Regulatory documents ensuring the unity of measurements.	10	-
3	LC Classification and measurement methods	2	-
	PR Study of the boundaries of the main error of analog and digital devices.	2	-
	PR Determination of additional measurement error.	2	-
	SR Reference base in Ukraine.	6	-
4	LC Measuring instruments and their metrological characteristics.	2	-
	PR Selection of measuring instruments according to the class of accuracy.	2	-
	CP Conditions for the use of measuring instruments.	8	-
5	LC Classification and characteristics of measurement errors.	2	-
	PR Determination of absolute and relative measurement errors.	2	-
	CP Correctness, reproducibility and convergence of measurement results.	6	-
6	LC Detection, adjustment of systematic and progressive errors.	2	-

	PR Determination of methodological error.	2	-
	CP Adjustment of systematic errors. Compatible summation of systematic and random errors.	8	-
7	LK Processing of measurement results.	2	-
	PR Ejection of results distorted by gross errors of observations.	2	-
	CP Statistical relationship between errors.	6	-
8	LK Fundamentals of measurement uncertainty.	2	-
	CP Uncertainty of measurement of type A and type B.	8	-
Toget her	LUX	16	-
	AVE	16	-
	WED	58	-

Individual educational and research task:

1. Evaluate the measurement errors of physical quantities specified by the teacher.

Teaching Methods:

- 1) verbal: 1.1 traditional: lectures, explanations, narration, etc.;
- 1.2 interactive (non-traditional): problem lectures, discussions, etc.;
- 2) visual: the method of illustrations, the method of demonstrations
- 3) practical: 3.1 traditional: practical classes, seminars;
- 3.2 interactive (non-traditional): training, brainstorming method.

Grading system and requirements:

Current success

1 The current success of applicants for the performance of educational types of work in training sessions and for the performance of tasks of independent work is assessed using a four-point scale of grades, followed by recalculation into a 100-point scale. During the assessment of current performance, all types of work provided for by the curriculum are taken into account.

1.1 Lectures are evaluated by determining the quality of the specified tasks.

1.2 Practical classes are assessed by the quality of the control or individual task, the performance and design of practical work.

2 Evaluation of the current performance of applicants for higher education is carried out at each practical lesson (seminar) on a four-point scale ("5", "4", "C", "2") and recorded in the journal of academic performance.

– "excellent": the applicant perfectly mastered the theoretical material, demonstrates deep knowledge of the relevant topic or academic discipline, the main provisions;

- "good": the applicant has well mastered the theoretical material, owns the main aspects from the primary sources and the recommended literature, argues mentally, teaches it; has practical skills, expresses his reasoning about certain problems, but assumes certain inaccuracies and errors in the logic of presentation of theoretical content or in the analysis of practical;

- "satisfactory": the applicant has mainly mastered the theoretical knowledge of the educational topic, or discipline, is guided in the primary sources and the recommended literature, but unconvincingly answers, confuses concepts, uncertainly answers additional questions, does not have stable knowledge; answering questions of a practical nature, reveals inaccuracy in knowledge, does not know how to evaluate facts and phenomena, connect them with a future profession;

– "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, is almost not oriented in primary sources and recommended literature, there is no scientific thinking, practical skills are not formed.

3 The final score for current activities is recognized as the arithmetic average sum of points for each lesson, for individual work, current tests according to the formula:

$$K^{nomoch} = \frac{K1 + K2 + \dots + Kn}{n},$$

where K^{nomoch} is the final assessment of success based on the results of current control;
 $K1, K2, \dots, Kn$ – assessment of the success of the n -th measure of current control;
 n – the number of measures of current control.

Prices are converted into points according to the recalculation scale (Table 1).

Table 1 – Recalculation of the average score for current activities in a multi-point scale

4-point scale	100- point scale	4- point scale	100- point scale	4- point scale	100- point scale	4- point scale	100- point scale
5	100	4,45	89	3,90	78	3,35	67
4,95	99	4,4	88	3,85	77	3,3	66
4,9	98	4,35	87	3,80	76	3,25	65
4,85	97	4,3	86	3,75	75	3,2	64
4,8	96	4,25	85	3,7	74	3,15	63
4,75	95	4,20	84	3,65	73	3,1	62
4,7	94	4,15	83	3,60	72	3,05	61
4,65	93	4,10	82	3,55	71	3	60
4,6	92	4,05	81	3,5	70	from 1,78 to 2,99	from 35 to 59
						Reassembly	
4,55	91	4,00	80	3,45	69	from 0 to 1,77	from 0 to 34
4,5	90	3,95	79	3,4	68	Re-study	

Final assessment

1 The applicant for higher education receives credit at the last lesson in the discipline based on the results of the current assessment. The average score for current activities is converted into points on a 100-point scale, according to the recalculation table (Table 1). Applicants for higher education who have an average current grade in a discipline lower than "3" (60 points) in the last lesson can increase their current score by passing tests in the discipline.

Evaluation of the knowledge of applicants by testing is carried out on a scale:

- "Excellent": not 90% correct answers;
- "Very good": from 82% to 89% of correct answers;
- "Good": from 74% to 81% of correct answers;
- "Satisfactory": from 67% to 73% of correct answers;
- "Satisfactory enough": from 60% to 66% of correct answers;
- "Unsatisfactory": less than 60% of correct answers.

2 The condition for obtaining the test is:

- working out all missed classes;
- the average current score in the discipline is not lower than "3" (60 points).

3 For the implementation of individual independent work and participation in scientific events, applicants are awarded additional points.

3.1 Additional points are added to the sum of points scored by the higher education student for current academic activities (for disciplines for which the test is the final form of control), or to the final grade in the discipline for which the exam is the final form of control .

3.2 The number of additional points awarded for different types of individual tasks depends on their volume and significance:

- prizes in the discipline at the international / all-Ukrainian competition of scientific student works – 20 points;

- prizes in the discipline at the All-Ukrainian Olympiads – 20 points;

- participation in the international / all-Ukrainian competition of scientific student works – 15 points

- participation in international / all-Ukrainian scientific conferences of students and young scientists – 12 points;

- participation in all-Ukrainian olympiads in the discipline – 10 points

- participation in olympiads and scientific conferences of KhNADU in the discipline – 5 points;

- implementation of individual research (educational and research) tasks of increased complexity – 5 points.

3.3 The number of additional points may not exceed 20 points.

4 The result of training is evaluated:

- on a two-point scale (credited/not credited) according to table 2;

- on a 100-point scale (for differentiated standings) according to Table 3.

The final score, together with additional points, cannot exceed 100 points.

Table 2 – Scale of transfer of points to the national grading system

On a 100-point scale	On a national scale
from 60 points to 100 points	enrolled
less than 60 points	unzached

Table 3 – Scale of assessment of applicants' knowledge based on the results of the final control in the discipline

Score in points	National scale score		ECTS score	
			Score	Criteria
	Exam	Passed		
90-100	Perfectly	Enrolled	A	The theoretical content of the course is mastered entirely, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided by the training program have been completed, the quality of their implementation is estimated by the number of points close to the maximum

Score in points	National scale score		ECTS score	
			Score	Criteria
	Exam	Passed		
80–89	Well	Enrolled	B	The theoretical content of the course is mastered entirely, without gaps, the necessary practical skills in working with the mastered material are mainly formed, all the training tasks provided by the training program have been completed, the quality of most of them is estimated by the number of points close to the maximum
75-79			With	The theoretical content of the course is mastered entirely, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the training tasks provided by the training program have been completed, the quality of none of them is assessed by the minimum number of points, some types of tasks are performed with errors
67-74	Satisfactory		D	The theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills in working with the mastered material are mainly formed, most of the training tasks provided by the training program have been completed, some of the tasks performed may contain errors
60–66			And	The theoretical content of the course is partially mastered, some practical skills of work are not formed, many of the training tasks provided by the training program have not been completed, or the quality of some of them is estimated by the number of points close to the minimum.
35–59	Disappointing	Not credited	FX	The theoretical content of the course is partially mastered, the necessary practical skills of work are not formed, most of the provided training programs have not been completed, or the quality of their implementation is estimated by the number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the training tasks (with the possibility of re-compilation)

Score in points	National scale score		ECTS score	
			Score	Criteria
	Exam	Passed		
0–34	Unacceptable		F	The theoretical content of the course has not been mastered, the necessary practical skills of work are not formed, all completed training tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the training tasks (with a mandatory repeated course)

Course Policy:

- ursinvolves working in a team, withthe audience being friendly, creative, open to constructive criticism;
- mastering the discipline involves the obligatory attendance of lectures and practical classes, as well as independent work;
- independent work involves the study of individual topics of the discipline, which are made in accordance with the program for independent study, or were considered briefly;
- insi, the tasks envisaged by the program must be completed within the prescribed period;
- if the applicant for higher education is absent from the classroom for a good reason, he presents the completed tasks during the independent preparation and consultation of the teacher;
- while studying the course, applicants for higher education must comply with the rules of academic integrity set forth in the following documents: "Rules of academic integrity of participants in the educational process of KhNADU" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.p df), "Academic integrity. Verification of the text of academic, scientific and qualification works for plagiarism" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85_1_01.pdf), "Moral and ethical code of participants in the educational process of KhNADU" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf).
- in case of detection of the fact of plagiarism, the applicant receives 0 points for the task and must re-complete the tasks provided for in the syllabus;
- writing during tests and exams is prohibited (including using mobile devices). Mobile devices are allowed to be used only during online testing.

Recommended literature:

1. Fundamentals of metrology and metrological activity: textbook / O.M. Velichko, L.V. Kolomiets, T.B. Gordienko; per zag. Ed. O. M. Velichka. – Kherson: OLDI-PLUS, 2021. – 574 p.
2. Vasilevsky, O. M. Uncertainty of the results of measurements, control and tests: textbook / O. M. Vasilevsky, V. Y. Kucheruk, E. T. Volodarsky. – Kherson: OLDI-PLUS, 2020. – 350 p.
3. Fundamentals of metrology and measuring instruments: textbook / D.M. Nesterchuk, S.O. Kvitka, S.V. Galko. – Melitopol: Publishing and Printing Center "Lux", 2017. - 256 p.
4. Methodical instructions for practical work. Access mode:

https://dl2022.khadi-kh.com/pluginfile.php/219265/mod_resource/content/1/%D0%9C.%D0%92.%20%D0%B4%D0%BB%D1%8F%20%D0%9F%D0%97%20%D0%BF%D0%BE%20%D0%9E%D1%81%D0%BD.%D0%BC%D0%B5%D1%82%D1%80%D0%BE%D0%BB%D0%BE%D0%B3%D1%96%D1%97.pdf

Additional Sources:

1. Distance course. Access mode:
<https://dl2022.khadi-kh.com/course/view.php?id=3970>
2. The legislative basis of metrology. Access mode:
<https://zakon.rada.gov.ua/laws/show/1314-18#Text%D1%85%D1%83...pdf>
3. Amendments to the Law of Ukraine "On Metrology and Metrological Activity" of January 15, 2015 N 124-VIII.

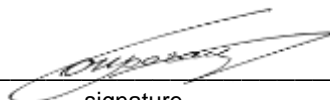
Developer (developers)
syllabus of the discipline



signature

Natalia DIDENKO

Head of the Department



signature

Oleg BOGATOV