# Syllabus educational component

### Principles of construction of measurement signals spaces

Discipline name:	Principles of construction of
	measurement signals spaces
Level of higher education:	first (bachelor's)
Course page in Moodle:	https://dl2022.khadi-
	kh.com/course/view.php?id=4165
The volume of the educational	4 credits (120 hours)
component	
Form of final control	Passed
Consultations:	on schedule
Name of the department:	Department of Metrology and Life
	Safety
Language of instruction:	English
Course leader:	Oleksandr Polyarus, Doctor of
	Technical Sciences, Professor
Contact phone number:	+38 096-213-08-89
Email:	poliarus.kharkov@ukr.net

#### Summary of the educational component:

**The goal is** toprovide students with competencies, knowledge, skills and abilities in basic x methods of presenting signals in functional spaces.

**Subject**: theoretical and methodological foundations of signal representation in functional spaces.

## The main tasks of studying the discipline are:

 formation of systems of knowledge, skills and ideas about the current state of development of methods for presenting measuring signals;

- assessment of the possibilities of using methods of signaling in metrological practice;
- formation of signal classification skills;
- formation of skills for evaluating signal parameters.

## Prerequisites for studying the educational component:

Higher Mathematics, Physical Quantities and Measurements.

## Competences that the applicant acquires:

#### General competencies:

Ability to apply professional knowledge and skills in practical situations; Ability to search, process and analyze information from various sources Skills in the use of information and communication technologies Ability to evaluate and ensure the quality of work.

## Special (professional) competencies:

Ability to analyze the components of the error according to their essential features, to operate with components of error / uncertainty in accordance with measurement models.

Ability to use modern engineering and mathematical packages to create models of instruments and measurement systems.

Ability to apply standard calculation methods in the design of modules, parts and assemblies of measuring instruments and their computational components and modules.

#### Learning outcomes:

Be able to find reasonable solutions in the preparation of structural, functional and schematic diagrams of information and measuring equipment.

Know and understand the basic concepts of metrology, measurement theory, mathematical and computer modeling, modern methods of processing and assessing the accuracy of a measuring experiment.

Understand the broad interdisciplinary context of the specialty, its place in the theory ofknowledge and evaluation of objects and phenomena.

Know and understand the subject area, its history and place in the sustaina development of technology and technology, in the general system of knowledge abnature and society.

Be able to create models of measuring equipment using modern engineering and mathematical packages.

		Number of	
Topic number	Title of topics (LK LR PR SZ WED)	no	urs Corres
		Eve	ponde
		<b>,</b> -	nce
	LK Philosophy of Measurement. Physical and probabilistic measures.	2	2
1	PR Practice of reconciling physical and probabilistic measures	2	2
	in measurements.	4.0	
	CP Application of topological space to create measures.	12	14
	LC Signal classification.	2	-
2	PR Problems of attributing a signal to a specific class or	2	-
_	classes.	-	
	CP Features of signals of different types.		-
	LC Functional signal spaces.	2	-
3	PR Determination of distances between signals in metric	2	-
Ū	spaces.	-	
	CP Signaling in Hilbert space.	12	14
	LC Orthogonal signals and their applications.	2	-
4	PR Determination of signal projections based on design theory	2	-
	CP The use of orthogonal signals in metrological practice	12	14
	LC Signals in discrete systems.	2	-
5	PR Signal processing in the simplest discrete systems.	2	-
	WED. The main provisions of the Z-transformation.	12	14
6	LC Spectral signal analysis.	2	-
	PR Signal presentation in the form of a weighted sum of	2	-
	CP Signal analysis with window functions.	12	14

#### Thematic plan

7	LK Spectral-temporal signal analysis and wavelet transformation.	2	-
	PR Application of wavelet conversion for signal analysis	2	-
	CP Foundations of the Haar, Walsh-Adamar Transformations, Hartley	8	14
	LK Analysis of random signals.	2	2
8	PR Evaluation of the characteristics of random signals.	2	2
	CP Classification of random signals.	8	14
Togoth	LUX	16	4
rogeth	PR (LR, NW)	16	4
er	WED	88	112

## Individual educational and research task:

Give signals in different functional spaces.

## **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 performance 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 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 primary sources and recommended literature, reasonably teaches it; has practical skills, expresses his reasoning about certain problems, but assumes certain inaccuracies and errors in the logic of presenting theoretical content or in the analysis of practical;

– "satisfactory": the applicant has mainly mastered the theoretical knowledge of an educational topic or discipline, is oriented in primary sources and recommended literature, but unconvincingly answers, confuses concepts, uncertainly answers additional questions, does not have stable knowledge; answering questions of a practical nature, reveals inaccuracies 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:

$$K^{nomov} = \frac{K1 + K2 + \ldots + Kn}{n},$$

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

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

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
						Reasser	nbly
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-stu	dy

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

## **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 1 00-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.

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

- "Excellent": at least 90% of 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	not credited

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

Score	Nationa	al scale	ECTS score			
in points	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		
80–89	pa		В	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 <b>A To W</b>		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			

Score	Nationa	National scale		ECTS score			
in points	score		Score	Criteria			
ponno	Exam	Passed					
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	t 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)			
0–34	Unacceptable No		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:

- the course involves teamwork, the environment in the audience is 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 submitted in accordance with the program for independent study or were considered briefly;

- all tasks stipulated 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" (<u>https://www.khadi.kharkov.</u>)

ua/fileadmin/P Standart/pologeniya/stvnz 67 01 dobroch 1. pdf), "Academic integrity. Verification of the text of academic, scientific and gualification works for plagiarism" (https://www.khadi.kharkov.ua/fileadmin/P\_Standart/pologeniya/stvnz\_85\_1\_01.pdf), "Moral KhNADU ethical code of participants in the educational process of and (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;

- write-offs during tests and exams are prohibited (including using mobile devices). Mobile devices are only allowed to be used during online testing.

## Recommended literature:

- 1. Polyarus O.V., Karlov V.D., Milkevich E.O. Theory of electrical signals and circuits. Educational and methodical manual. – Kharkiv: KhNADU, 2009. – 308 p.
- 2. Polyarus O.V. Methodical instructions for practical classes on the discipline "Theory of electrical signals and circuits". Kharkiv: KhNADU, 2014. 183 p.
- 3. Ace Y. M., Shumkov Y. S. Theory of electrical circuits and signals. Tutorial. Kyiv: NTUU "KPI", 2012. 448 p.
- 4. K. W. Jenkins. Teach yourself algebra for electric circuits. McGraw-Hill. 561 p.
- 5. Voloshchuk Y. I. Signals and processes in radio engineering: A textbook for students of higher educational institutions, volume 1.- Kharkiv: "SMITH Company", 2003. 580 p.
- Voloshchuk Y. I. Signals and processes in radio engineering: A textbook for students of higher educational institutions, volume 2.- Kharkiv: "SMITH Company", 2003. - 444 p.
- Polyarus O.V., Polyakov E.O. Approximate solution of the inverse problem of measurements and its metrological support. - Monograph.- H.: Leader Publishing, 2014. – 120 p.
- 8. Popov A.O. Theory of signals. Educational and methodical manual. Kyiv: KPI them. Igor Sikorsky, 20 1 9. 270 p.
- 9. Babak V.P., Yeremenko V.S., Kuts Yu.V., Myslovych M.V., Shcherbak L.M. Models and measures in measurements. Kyiv, Naukova Dumka, 2019. 208 p.

## Additional Sources:

1. Distance course. Access mode: https://dl2022.khadi-kh.com/course/view.php?id=4165

2. Fundamentals of the theory of circles, signals and processes in the systems of technical protection of information: a textbook for students of higher educational institutions. Part 1. Authors: Koval Yu.O., Mylyutchenko I.O., Oleynikov A.M., Shokalo V. m. <u>http://openarchive.nure.ua/handle/document/1388</u>.

3. V.M. Bondarenko, M.P. Trembovetsky, P.V. Afanasiev, E.V. Ivanichenko. Theory of Electrical Circuits and Signals. - 2018. <u>https://dut.edu.ua/ru/lib/1/category/96/view/1719</u>.

4. Zinchenko O. E., Rodionov S. V. Theory of electrical circuits and signals, 2020. http://lib.kart.edu.ua/handle/123456789/4058

Developer syllabus of the discipline	signature	Oleksandr POLYARUS.
Head of the Department	Ouperant	Oleg BOGATOV