Syllabus
of the selective component

Optimization Methods in Measuring Information Systems

Name of the discipline:	**Optimization Methods in Measuring Information Systems**
Higher education level:	**First (bachelor's)**
Course page in Moodle:	*https://dl2022.khadi-kh.com/course/view.php?id=2948*
Scope of the educational component	**4 credits (120 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:	**Oleksandr Koval, Ph.D., Associate Professor**
Contact phone:	*(+380)686062067*
Email:	*koval_al@ukr.net*

Summary of the educational component:
The goal is to develop research skills in the field of theory and methodology of measurement optimization in measuring information systems, to instill practical skills and abilities to apply the basic methods of optimization of the construction and measurement algorithms of measuring information systems.
Subject*:* theoretical and methodological foundations of methods for optimizing the construction and measurement algorithms of measuring information systems.
The main tasks of studying the discipline are:

– substantiation and presentation of unified theoretical and methodological foundations of the principles of optimization of the construction of measuring information systems;

– substantiation and presentation of unified theoretical and methodological foundations of the principles of optimization of measurement algorithms of measuring information systems;

– formation of directions for improvement and development of methods, methods of optimization, construction and measurement algorithms of measuring information systems;

– formation of skills for organizing independent research work and presentation of scientific research results.

Prerequisites for studying the educational component:
Introduction to Systems Theory, Fundamentals of Metrology and Measuring Technology, Microprocessor Measuring Instruments, Measuring Transducers, Methods for Determining the Metrological Characteristics of Measuring Instruments.

Competencies that the applicant acquires:
***General competencies*:**

Ability to abstract thinking, analysis, synthesis and application of knowledge in practical situations;

Ability to apply professional knowledge and skills in practical situations;

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

Special (professional) competencies:

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

Ability, based on the measuring problem, to explain and describe the principles of constructing the computational components of measuring equipment.

Ability to apply the results of mathematical, physical (analytical and simulation) studies of models and methods used in the design of measurement processes, during modeling, formulation and solution of engineering problems; mastery of modern computer technologies in the study of various models using special programs of application software.

Ability to apply basic knowledge of methods and measures aimed at ensuring, maintaining and increasing the reliability of data processing of measurement, testing and control of products at all stages of their life cycle, as well as the study of modern information and analytical technologies for data processing.

Learning outcomes:

To be able to deepen the acquired and acquire new professional knowledge in accordance with the latest stages of development of advanced technologies, equipment and methods of organizing technological processes, to be competent in advanced professional issues.

Be able to use information technologies, software and the Internet in solving specific problems of professional activity.

Be able to find reasonable solutions when drawing up structural, functional schemes of information and measuring equipment.

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

Thematic plan

Topic No.	Name them (LK, LR, PR, SZ, SR)	Number of hours
		Eye
1	LC1. General characteristics of optimization methods in measuring information systems.	2
	PR1. Method of metrological synthesis of the structure of the measuring pressure information system.	2
	SR1. Metrological analysis of the synthesized structure of the measuring pressure information system.	11
	LC2. Methods for finding optimal values of parameters of the elements of the temperature measuring information system.	2
	PR2. Methods for optimizing the sensitivity functions of the elements of the measuring information system of temperature.	2
	SR2. Application of the analytical method to select the optimal values of the parameters of the measuring channel of active resistance.	11
2	LC3. Methods for optimizing holonomic measuring information systems.	2
	PR3. Methods for finding the optimal structure of the measuring information system of environmental meteorological parameters.	2
	SR3. Methods and methods of increasing the signal-to-noise ratio at the output of the measuring information system of environmental meteorological parameters..	11
	LC4. Methods for optimizing analog interfaces of measuring information systems.	2

Topic No.	Name them (LK, LR, PR, SZ, SR)	Number of hours
		Eye
	PR4. Method for determining the accuracy class of the signal matching device in the measuring pressure information system.	2
	SR4. Minimax parametric criteria for optimization of multichannel measuring information systems.	11
3	LC5. Methods for correcting the dynamic characteristics of measuring channels of measuring information systems.	2
	PR5. Methodology for using the internal control method to correct the dynamic characteristics of sensors of the measuring information system of temperature.	2
	SR5. Methodology for assessing the criterion of the minimum difference in transient characteristics of the sample and operating sensors of the measuring temperature information system.	11
	LC6. Dynamic compensator for measurement error due to the "aging" of measuring channels.	2
	PR6. Development of a model of a dynamic compensator for measurement error caused by the "aging" of the temperature measuring channel.	2
	SR6. Methodology for developing a model of a dynamic compensator for measurement error due to the "aging" of the pressure measuring channel.	11
	LC7. Neural network methods for correcting the transient characteristics of pressure and temperature measuring channels.	2
	PR7. Development of a model of dynamic compensation error of pressure measurement.	2
	SR7. Features of building a model of dynamic compensatory error in temperature measurement.	11
4	LC8. Methods for calculating the metrological characteristics of the measuring channels of the measuring information system according to the metrological characteristics of the components.	2
	PR8. Method for calculating the metrological characteristics of measuring channels of a 3-channel measuring pressure information system in stationary dynamic mode.	2
	SR8. Methods for calculating the metrological characteristics of measuring channels of a 3-channel measuring pressure information system in static mode.	3
	LC9 Methods of statistical analysis of measurement errors.	2
	LC10 Multivariate Analysis Method	2
	LC11 Methods for determining the impact of changes in system parameters on measurement results.	2
	LK12 Methods for evaluating sensitivity and measurement range.	2
Together	LUKE	24
	PR	16
	WED	80

Individual educational and research task: not provided.

Teaching methods:

MH1 – verbal method (lecture, educational discussion, explanation, story);

MH2 – practical method (practical classes);

MH3 – visual method (method of illustrations, method of demonstrations);

MH4 – work with literature (educational and methodological; normative literature; search for information on the task);

MH5 – video method in combination with the latest information technologies and computer learning tools (distance);

MH6 – independent work;

Forms and methods of assessment

FMO2 – final control (credit)

FMO4 – written control (individual tasks)

FMO5 – test control (standardized tests, final complex tests)

FMO7 – practical test (defense of practical works)

Grading System and Requirements:

Assessment in the discipline and its transfer into grades on the national scale and the ECTS scale is carried out in accordance with STVNZ 90.1-02:2023 "Assessment of the learning outcomes of higher education applicants".

Current Academic Performance

1 The current performance of applicants for the performance of educational types of work in training classes and for the performance of tasks of independent work is evaluated using a four-point scale of assessments with subsequent recalculation in a 100-point scale. When assessing 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 performance of specified tasks.

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

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

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

– "good": the applicant has mastered the theoretical material well, knows the main aspects from primary sources and recommended literature, presents it in a reasoned manner; has practical skills, expresses his thoughts on certain problems, but makes certain inaccuracies and errors in the logic of presenting theoretical content or in the analysis of practical content;

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

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

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

$$K^{curent} = \frac{K1 + K2 + ... + Kn}{n},$$

where K^{curent} is the final assessment of success based on the results of current control;

$K1, K2, ..., Kn$ – assessment of the success n of the current control measure;

n – the number of current control measures.

Grades are converted into points according to the conversion scale (Table 1).

Table 1 – Recalculation of the average score for current activities into 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	1.78 to 2.99	35 to 59
						Reassembly	
4,55	91	4,00	80	3,45	69	0 to 1.77	0 to 34
4,5	90	3,95	79	3,4	68	Re-study	

Final assessment

1 A higher education applicant receives a credit at the last lesson in the discipline according to the results of the current assessment. The average grade for the current activity is converted into points on a 100-point scale, according to the conversion table (Table 1).

Applicants for higher education Education who have an average Current Assessment with disciplines lower than "3" (60 points), upon Last classes can increase their current score by taking tests with Discipline.

Assessment of applicants' knowledge 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 offset is:

– working out all missed Classes;
– average current grade in the discipline not lower "3" (60 points).

3 For the performance 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 applicant for higher education for the current educational activity (for disciplines, the final form of control for which is a test), or to the final grade in the discipline, the final form of control for which is an exam.

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 KhNAHU in the discipline – 5 points;

– performance of individual research (educational and research) tasks of increased complexity – 5 points**.**

3.3 The number of additional points cannot exceed 20 points.

4 The learning outcome is evaluated *(choose the one you need):*

– on a 100-point scale (for a differentiated test) according to Table 2.

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

Table 2 – Scale of assessment of applicants' knowledge based on the results of the final control in the academic discipline

Score in points	National scale score		ECTS score	
			Score	Criteria
	Exam	Passed		
90-100	**Perfectly**	**Credited**	**A**	The theoretical content of the course has been mastered completely, without gaps, the necessary practical skills in working with the mastered material have been formed, all the educational tasks provided for by the training program have been completed, the quality of their implementation has been evaluated by the number of points close to the maximum
80–89	**Well**	**Credited**	**B**	The theoretical content of the course is mastered completely, without gaps, the necessary practical skills of working with the mastered material are basically formed, all the educational tasks provided for by the training program are completed, the quality of most of them is evaluated by the number of points close to the maximum
75-79			**C**	The theoretical content of the course is mastered completely, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the educational tasks provided for by the training program have been completed, the quality of performance of any of them has not been evaluated by the minimum number of points, some types of tasks have been completed with errors
67-74	**Satisfactory**		**D**	The theoretical content of the course has been partially mastered, but the gaps are not significant, the necessary practical skills in working with the mastered material have been largely formed, most of the educational tasks provided for by the training program have been completed, some of the completed tasks may contain errors

Score in points	National scale score		ECTS score	
			Score	Criteria
	Exam	Passed		
60–66			**And**	The theoretical content of the course has been partially mastered, some practical work skills have not been formed, many of the training tasks provided for by the training program have not been completed, or the quality of some of them has been evaluated by the number of points close to the minimum.
35–59	**Disappointing**	**Not Credited**	**FX**	The theoretical content of the course has been partially mastered, the necessary practical skills have not been formed, most of the provided training programs for educational tasks have not been completed, or the quality of their implementation has been evaluated 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 educational tasks (with the possibility of re-compiling)
0–34	**Unacceptable**		**F**	The theoretical content of the course has not been mastered, the necessary practical skills have not been 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 educational tasks (with the obligatory repeated course)

Recognition of the results of non-formal and informal education

The procedure for recognizing learning outcomes obtained in non-formal and informal education is regulated by STVNZ-83.1-02:2022 "Recognition of the results of non-formal and informal education".

To recognize such results, it is necessary to apply to the dean of the faculty with a corresponding application and attach certificates, certificates and other documents confirming the received competencies. Based on the results of consideration of the application, a subject commission is created, which considers the submitted documents, conducts an interview with the applicant and makes a decision on the re-enrollment of the learning results or the appointment of certification in the form of a final control (10 working days are given for preparation). Based on the results of the control, the commission gives a final grade. If the applicant received less than 60 points, then the results of learning in non-formal or informal education are not counted. When re-enrolling the results of training in the discipline, the applicant is exempt from its study.

Course Policy:

– the course involves teamwork, the environment in the classroom is friendly, creative, open to constructive criticism;

– mastering the discipline involves mandatory attendance at lectures and practical classes, as well as independent work;

– independent work involves the study of individual topics of the academic discipline, which are submitted in accordance with the program for independent study, or were considered briefly;

– all tasks provided for by the program must be completed on time;

– if the applicant for higher education is absent from classes for a good reason, he/she presents the completed tasks during self-preparation and consultation with the teacher;

– during the study of 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 KhNAHU" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf), "Academic integrity. Checking the text of academic, scientific and qualification papers for plagiarism" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85.1-02.pdf), "Moral and ethical code of participants in the educational process of KhNAHU (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;

– cheating during tests and exams is prohibited (including the use of mobile devices). Mobile devices are allowed to be used only during online testing

Recommended literature:

1. Koval A. O., Koval O. A. Spatially Distributed Intelligent Measuring Information Systems: Monograph. Kharkiv: Leader, 2017. 146 p. URL: https://dspace.khadi.kharkov.ua/dspace/bitstream/123456789/2585/1/Prostorovo%20rospod%20%D0%86%D0%92%D0%86%D0%A1.pdf/ (дата звернення 21.08.2024).

2. Koval A. O. Methods of optimization in measuring information systems: lecture notes [Electronic resource] ; Ministry of Education and Science of Ukraine, Kharkiv. National. Automobile-Dor. - Kharkiv, 2024. 88 p. URL: https://griml.com/26b8u.
(accessed 21.01.2022).

3. Methodical recommendations for conducting practical classes in the discipline "Methods of optimization in measuring information systems": [Electronic resource] / [compiled by O. A. Koval]; Kharkiv, 2024. 59 p. URL: https://griml.com/wnNlA (accessed 21.08.2024).

Additional sources:

1. Distance course: *https://dl2022.khadi-kh.com/course/view.php?id=2948*.

Developer
syllabus of the academic discipline _____ Oleksandr KOVAL
Signature Full Name

Head of the Department _____ Oleg BOGATOV
Signature Full Name