Syllabus
educational component

Industrial data processing

Discipline name:	**Industrial data processing**
Level of higher education:	**first (bachelor'sdegree)**
Course page in Moodle:	*https://dl2022.khadi-kh.com/course/view.php?id=2947*
The volume 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, Candidate of Technical Sciences, Associate Professor**
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Summary of the educational component:
The aim is to develop research skills in the field of theory and methodology for collecting, analyzing and processing measurement data in spatially distributed measuring systems of industrial enterprises, accustoming practical skills and abilities to apply basic methods and approaches for construction and reliable functioning of measuring clusters of industrial enterprises.
Subject*:* theoretical and methodological foundations of construction of measuring clusters.
The main tasks of studying the discipline are:

– substantiation and presentation of common theoretical and methodological foundations of the principles of construction of measuring clusters;

– study ofmethods of collection, processing and analysis of measurement data in spatially distributed measuring systems;

– formation of directions for the improvement and development of methods for collecting, processing and analyzing measurement data in industrial enterprises;

– formation of skills in organizing independent research work and presenting the results of scientific research.

Prerequisites for studying:
Introduction to Systems Theory Computing and Programming, Fundamentals of Metrology and Measuring Engineering, Microprocessor Measuring Instruments, Measuring Transducers; Methods for determining the metrological characteristics of measuring instruments.

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, the use of information and communication technologies;

Ability to learn and master modern knowledge, ability to identify, set and solve problems;

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.

The ability, based on the measuring problem, to explain and describe the principles of construction of computational components of measuring instruments.

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

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

Ability to apply basic knowledge of methods and measures aimed at ensuring, maintaining and increasing the reliability of data processing of measurement results, tests 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.

The ability to carry out adjustment and experimental testing of certain types of devices in laboratory conditions and at facilities

Learning results: 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 apply information technologies, software and the Internet in solving specific problems of professional activity.

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.

Be able to organize the procedure for measuring, calibration, testing when working in a group or separately.

Thematic plan

Topic number	Title of topics (LK, LR, PR, SZ, WED)	Number of hours	
		Eye	Correspondence
1	LK1. Industrial data processing. General information.	2	2
	PR1. Method of collecting measurement data by a multiparametrically distributed measuring system at a machine-building enterprise.	2	2
	CP1. Ways to implement measurement data collection schemes at a machine-building enterprise. .	11	11
	LK2. The purposeof processing and analyzing measurement data at a machine-building enterprise. .	2	2
	PR2. Methods of analysis of measurement data and forecasting of dynamic measurement errors at a machine-building enterprise.	2	2
	CP2. Methods of forecasting the metrological reliability of spatially distributed measuring systems at a machine-building enterprise.	11	11
2	LK3. Metrological cluster of a machine-building enterprise.	2	2

Topic number	Title of topics (LK, LR, PR, SZ, WED)	Number of hours	
		Eye	Correspondence
	PR3. Methods of construction of metrological clusters of machine-building enterprises.	2	2
	CP3. Methods and methods of storing measurement data in the metrological cluster of machine-building enterprisesa. .	11	11
	LK4. The system of monitoring and analytics of the metrological cluster of the machine-building enterprise.	2	2
	PR4. Methods for detecting anomalies in the functioning of units and assemblies of the enterprise according to the results of the analysis of the metrological cluster.	2	2
	CP4. Features of the construction of metrological clusters of corporations, engineering industry.	11	11
3	LK5. The basics of promislovogo I ternetin things.	2	2
	PR5. Method of using Raspberry Pi and Orange Pi in the metrological cluster of a machine-building enterprise.	2	2
	CP5. Methods in bothmercuryandzatsiya in the metrological cluster of a machine-building enterprise.	11	11
	LK6. The method of using the Raspberry Pi and Orange Pi as gateways for digital sensors of the metrological clusterof a machine-building enterprise.	2	2
	PR6. Method of using Orange Pi as gateways for digital temperature sensors DS18B20	2	2
	CP6. Features of the use of single-board industrial computers as gateways of data subsystems metrologicallyth clusterin.	11	11
	LK7. Method of using single-board computers Raspberry Pi and Orange Pi as gateways analog sensors of the metrological cluster of a machine-building enterprise.	2	2
	PR7. The method of using single-board computers Orange Pi as gateways analog sensors andISKU SAFIR.	2	2
	CP7. Features of using a single-board computer a Orange Pi as a gatewayfor ultrasonic distance sensors HC-SR04.	11	11
4	LK8. Methods for assessing the uncertainty of measurements in the distribution of distributed multiparametric measuring systems of an industrial enterprise.	2	2
	PR8. Methodology for assessing the influence of non-identity of measuring channels on the total uncertainty of multiparametricmeasuring systemsand industrial enterprises.	2	2
	CP8. Methods of eliminating the uncertainty of the results of the analysis of measurement data and the carrier of metrological reliability in the metrological cluster of an industrial enterprise.	11	11

Topic number	Title of topics (LK, LR, PR, SZ, WED)	Number of hours	
		Eye	Correspondence
Together	LUX	16	16
	AVE	16	16
	WED	88	88

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): business and role-playing games, trainings, discussion seminars, "round table", 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.

1.3 Laboratory classes are assessed by the quality of the implementation of reports on the performance of laboratory work.

1.4 Seminars are evaluated by the quality of the individual task / abstract.

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

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

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

Oprices 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 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 *(choose the right one)*:

– 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	unzarached

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
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

Score in points	National scale score		ECTS score	
	Exam	Passed	Score	Criteria
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)
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:

– 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 made in accordance with the program for independent study, or were considered briefly;

– all 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;

– course work must be protected no later than a week before the start of the examination session ***(indicated if available)*;**

– 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.pdf), "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;
– 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: *(literature no later than 10 years, except for 1 fundamental classical textbook or monograph)*

1. Koval A.O., Koval O.A. Spatially distributed intellectual 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/ (accessed 21.01.2022).
2. Koval A.O. Measuring algorithms: lecture notes [Electronic resource] / A.O. Koval ; Ministry of Education and Science of Ukraine, Kharkiv. National. automob.-dor. un-t. - Kharkiv, 2018. 41 p. URL: ftp://194.44.189.147/libfulltxt/UCHLIB/KL/2018/KL_vymir_alg_Koval_2018.pdf. (accessed 21.01.2022).
3. Guide for laboratory work on discipline "Measuring algorithms" : for students of the field of knowledge 0510 "Metrology, measuring technology and information-measuring technologies of special. " Metrology and Measuring Technology" educationally-qualificats. level "bachelor" [Electronic resource] / [compiled by: A.O. Koval, O.A. Koval] ; Kharkov. National. automob.-dor. un-t. - Kharkiv, 2018. 39 p. URL: https://dspace.khadi.kharkov.ua/dspace/bitstream/123456789/2607/1/Koval_posib_lab_2018.pdf (accessed 21.01.2022).
4. Koval, O. A. Methods of synthesis and analysis of measured signals: lecture notes; Kharkiv National Automobile and Highway University. Kharkiv, 2018. 367 p. URL: https://dspace.khadi.kharkov.ua/dspace/handle/123456789/2605 (accessed 21.01.2022).

Additional Sources:

1. distance course: *https://dl2022.khadi-kh.com/course/view.php?id=2947*.
2. http://edu.asu.in.ua/course/view.php?id=4#section-1

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