# Syllabus selective educational component

#### Metrological reliability

Discipline name:	Metrological reliability
Level of higher education:	second (master's)
Course page in Moodle:	https://dl2022.khadi-kh.com/course/view.php?id=1004
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:	Oleg Bogatov, Candidate of Technical Sciences,
	Associate Professor
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#### Summary of the educational component:

- **The goal** is for students to master the basic ideas and methods of ensuring the reliability of measuring instruments, to acquire skills in typical approaches and methods of diagnosis and calculation of reliability during the design and operation of metrological facilities.
- **Subject:** theoretical and methodological foundations of reliability of measuring instruments, method of diagnosis and calculation of reliability during the design and operation of metrological means.

#### The main tasks of studying the discipline are:

- analysis of the reliability of metrological means at all stages of design, manufacture and operation;
- quantitative assessment of reliability, taking into account specific operating conditions;
- forecasting reliability on the basis of a priori information and modeling the processes of parameter drift;
- development and implementation of measures to improve the level of reliability of metrological means.

**Prerequisites for the study of the educational component:** Methods and means of measurement, Microprocessor measuring instruments, Electrotechnical devices of measuring information systems.

# Competences that the applicant acquires:

#### General competencies:

Knowledge and understanding of themain stages of development of the theory of reliability and reliability indicators.

Skills in using methods for calculating the reliability of measuring instruments during approximate, indicative and final reliability calculations.

Knowledge of modern means of automated calculation of reliability.

Ability to make informed decisions regarding the reliability of information-measuring systems.

#### Learning outcomes:

development and practical use of the main methods for calculating the reliability of metrological means;

study of the terminological apparatus and the main indicators of metrological; familiarization with the methods and methods of improving the reliability of metrological means;

gaining skills in solving engineering problems that take place in the development and operation of metrological facilities in terms of using theories of reliability and operation of metrological means.

	Thematic plan		
Topi		Number of	
ropi		hours	
	Title of topics (LK, LR, PR, SZ, WED)		Corres
hor		Eye	ponde
Der		-	nce
	LK Basic concepts of reliability theory.	2	1
1	PR (LR, SZ) Determination of indicators of reliability of measuring	2	
	instruments according to statistical data on failures	2	-
	CP Preparation for practical lesson No 1	9	12
	LC Indicators of reliability of metrological means	2	1
0	PR (LR, SZ). Calculation of indicators of reliability of measuring	0	
2	instruments for different laws of distribution of uptime	Z	
	SR Preparation for practical lesson No 2	9	12
	LK Bfloated various factors on the reliability indicators of measuring	2	1
	instrumentsь	2	I
3	PR (LR, SZ) Calculation of indicators of reliability of measuring	2	1
	instruments in the serial connection of their components	Z	I
	CP Preparation for practical lesson No 3	9	11
	LK Structural models of reliability of measuring instrumentsb	2	1
4	PR (LR, SZ) Calculation of reliability indicators of measuring	<u></u>	1
4	systems with general redundancy	Z	I
	SR Preparation for practical lesson No 4	9	11
	LK Metodes for calculating the reliability of measuring instruments	2	1
Б	PR (LR, SZ) Calculation of indicators of reliability of measuring	0	1
5	instruments during separate redundancy	Z	I
	CP Preparation for practical lesson No 5	9	11
	LK Calculation of the reliability of the means of measurementthat	0	1
	are restored	2	I
6	PR (LR, SZ) Calculation of reliability indicators of measuring	2	1
	systems during redundancy with fractional multiplicity	2	I
	CP Preparation for practical lesson No 6	9	11
	LK Avtomatized calculation of the reliability of measuring	2	1
	instruments	2	1
7	PR (LR, SZ) Calculation of reliability indicators of measuring	2	1
	systems during redundancy with fractional multiplicity	2	1
	CP Preparation for practical lesson No 7	9	11
	LC Btesting for the reliability of measuring instrumentsb	2	1
8	PR (LR, SZ) Calculation of indicators of reliability of measuring	2	1
	systems	2	1
	CP Settlement and graphic task	25	27
Togo	LUX	16	8
ther	PR (LR, NW)	16	6
	WED	88	106

Individual educational and research task (if any):

**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 the primary sources and the recommended literate of ry, argu 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 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:

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

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

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

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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-study		

 Table 1 – Recalculation of the average score for current activities in 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 of the final form of cont

**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			

#### 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;

- when 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;

- 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)

#### Bazova

- 1. Metrological reliability. Lecture notes / O.I. Bogatov, R.E. Pashchenko, A.O. Koval. Kharkiv: KhNADU, 2018. 95 p. [Electronic resource]
- Calculation of the reliability of metrological means. Practicum / O.I. Bogatov, R.E. Pashchenko, A.O. Koval. – Kharkiv: KhNADU, 2018. – 108 p.
- Methodical instructions for the implementation of course work on the discipline "Metrological Reliability" for students of the Mechanical Faculty of specialty 8.05100101 "Metrology and Measuring Technology" / O.I. Bogatov, R.E. Pashchenko, A.O. Koval. – Kharkiv: KhNADU, 2018. – 33 p. Electronic resource].
- 4. Reliability of equipment. Terms and definitions. DSTU 2860-94. [Electronic resource] Access mode: http://www.studfiles.ru/preview/5375587/

- Textbook "Fundamentals of Metrology" with a volume of 120 pages. authors Ignatkin V.U., Tomashevsky O.V., Matyushin V.M. "Fundamentals of Metrology" with a volume of 120 pages. authors Ignatkin V.U., Tomashevsky O.V., Matyushin V.M. — Zaporizhia: Zaporizhia National Technical University, — 2017. — 208 p.
- 6. GOST 27.301-95 Reliability in technology. Calculation of reliability. Main provisions
- Tomashevskyy O.V. Computer technologies of statistical data processing: 2nd edition of Zaporozhye: Zaporozhye scholar. manual, [Text] / O.V. Tomashevsky, V.P. Rysikov. 175 p. (stamp of the Ministry of Education and Science of Ukraine No 1/11-5523 from the national technical university, 2015. 15.04.2014).--
- Strogonov A. Review of software complexes for calculating the reliability of complex technical systems / Strogonov A., Zhadnov V., Polessky S. // Components and technologies – No 5, 2007. – P. 183 – 190.

## Secondary

- 9. Means of radio electronics. Reliability of redundant systems. DSTU 2566-94.
- 10. Reliability of electroradioproducts, 2006: reference book / S.F. Prytkov et al. M.: FSUE "22 TsNIII MO RF", 2008. 641 p.
- 11. Vasilevsky O.M. Rationing of indicators of reliability of technical means / Vasilevsky O.M., Podzharenko V.O. [Electronic resource] Access mode: http://posibnyky.vntu.edu.ua/v\_p/1.htm

## Information resources

- 1. http://www.fulbright.org.ua/page.php?pid=34&lang=1
- 2. www.tempus.org.ua
- 3. http://ec.europa.eu/education/index\_en.htm
- 4. http://www.irf.kiev.ua/ua/programs/inf/scaap/about/?doc:int=675.
- 5. http://www.earlham.edu/~peters/fos/brief.htm
- 6. www.nbuv.gov.ua
- 7. www.cs.vassar.edu/faculty/welty/papers/subjects/subject.html

Developer . syllabus of the discipline

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