# Silabus selective educational component

#### **Reliability and diagnostics of control systems**

Name of the discipline:	Reliability and diagnostics of control systems
Level of higher education:	first (bachelor's)
Educational and professional	Automation and computer-integrated technologies
(Educational and scientific)	
program:	
Course page in Moodle:	https://dl2022.khadi-kh.com/course/view.php?id=1623
The volume of the educational	3 credits (90 hours)
component	
Form of final control	Offset
Consultations:	on schedule
Name of the department:	ACIT department
Language of instruction:	Ukrainian
Course leader:	Zaporozhetsev Serhii Yuriiovych, PhD, Associate
	Professor
Contact phone number:	738-77-92
E-mail:	akit@khadi.kharkov.ua

## Summary of the educational component:

The purpose of studying the discipline is to form a system of theoretical and practical knowledge and skills in the field of reliability and diagnostics of automated control systems.

**Subject:** system of concepts about **reliability and diagnostics**, methods of their application and software tools for analysis and design.

# The main tasks of studying the discipline are:

- study of basic concepts and terminology of reliability theory and diagnostics;
- formation of computer modeling skills to study the reliability of automated curation systems;

 use of the latest technologies to study and calculate the reliability of systems and their characteristics.

### Prerequisites for studying the educational component:

The course requires systematic and thorough knowledge of related courses: higher mathematics, physics.

# Competencies acquired by the applicant:

### General competencies:

Ability to abstract thinking, analysis and synthesis.

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

Ability to make informed decisions.

### Special (professional) competencies:

Ability to apply methods of system analysis, mathematical modeling, identification and numerical methods to develop mathematical models of individual elements and automation systems as a whole, to analyze the quality of their functioning using the latest computer technology.

Ability to justify the choice of technical means of automation based on an understanding of the principles of their operation, analysis of their properties, purpose and

technical characteristics, taking into account the requirements for the automation system and operating conditions; to adjust technical means of automation and control systems.

## Learning outcomes in accordance with the educational program:

Be able to apply methods of system analysis, modeling, identification and numerical methods to develop mathematical and simulation models of individual elements and automation systems as a whole, to analyze the quality of their functioning using the latest computer technology to study and calculate the reliability of systems and their characteristics.

To be able to perform work on the design of automation systems, to know the content and rules of design materials, the composition of project documentation and the sequence of design work, taking into account the requirements of relevant regulations and international standards.

no of		Number of hours		
topic s	Name of topics (LC, LR, PR, NW, SR)	face- to-face	corresp ondenc e	
	LC Basic concepts of reliability of technical systems.	2		
1	PR General characteristics of the operating conditions of automated systems.	2		
	SR Definition of key reliability indicators	7		
	LC Main characteristics of reliability of elements and systems.	2		
2	PR Calculation of key reliability indicators.	2		
	SR . Examples of diagnostic object models	7		
	LC Main characteristics of reliability of elements and systems.	2		
3	PR Selection of the control method and a set of controlled parameters.	2		
	SR Software for synthesis of the minimum sufficient system of diagnostic tests	8		
	LC Improving the reliability of technical systems.	2		
4	PR Calculation of reliability indicators of non-renewable, non-redundant systems.	2		
	SR Algorithms for designing control and diagnostic systems	7		
	LC Methods of technical diagnostics.	2		
5	PR Calculation of reliability indicators of non-renewable redundant systems.	2		
	SR Software and hardware platforms for quality control	7		
	LC Software reliability methods.	2		
6	PR Improved reliability of technical systems.	2		
0	SR Recommendations for the development of software for control and diagnostic systems	8		
	LC Technology of expert systems development.	2		
_	PR Research of parameters of control and diagnostic systems.	2		
1	SR Application of reliability theory for safety assessment of technical systems	7		
8	LC. Prospects for the development of control and diagnostic systems.	2		

Thematic plan

	PR Development of recommendations on software for control and diagnostic systems.	2	
	SR. Algorithms of optimal control	7	
Togo	LC	16	
ther	PR	16	
	SR	58	

# Teaching methods:

1) verbal: 1.1 traditional: lectures, explanations, storytelling, etc;

2) visual: illustration method, demonstration method;

3) practical: 3.1 traditional: practical classes; experiential learning based on computer experiments.

# Evaluation system and requirements:

# Current academic performance

**1 The** current performance of applicants for the performance of educational types of work in class and for the performance of independent work tasks is assessed using a four-point grading scale with the subsequent conversion to a 100-point scale. When assessing current progress, all types of work provided by the curriculum are taken into account.

**1.1** Lecture classes are evaluated by determining the quality of specific tasks.

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

**2** Evaluation of the current progress of higher education students is carried out at each practical lesson on a four-point scale ("5", "4", "C", "2") and recorded in the academic record book.

- "excellent": the applicant has perfectly mastered the theoretical material, demonstrates in-depth knowledge of the relevant topic or discipline, the main provisions;

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

- "satisfactory": the applicant has basically mastered the theoretical knowledge of the subject or discipline, is oriented in the primary sources and recommended literature, but unconvincingly answers, confuses concepts, hesitates to answer additional questions, does not have stable knowledge; answering questions of a practical nature, shows inaccuracy in knowledge, is unable to evaluate facts and phenomena, to relate them to the 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 the current activity is recognized as the arithmetic mean of points for each class, for individual work, current control works according to the formula:

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

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

 $K1, K2, \dots, Kn$  - assessment of the success of the *n* current control measure;

# n - number of current control measures. Scores are converted into points according to the conversion scale (Table 1).

 Table 1 - Conversion of the average score for the current activity 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	from 1.78 to 2.99	from 35 to 59
						reassen	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-examination	

# **Final evaluation**

**1** A higher education student receives a credit at the last class of the discipline based on 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).

Higher education applicants who have a current average grade in the discipline below "3" (60 points) in the last class can increase their current score by taking 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 receiving credit is:

- working off all missed classes;

- the average current grade in the discipline is not lower than "3" (60 points).

**3** Additional points are awarded for individual independent work and participation in scientific events.

**3.1** Additional points are added to the sum of points gained by the applicant for higher education for current educational activities (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;

- prize places in the discipline at the national competitions - 20 points;

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

- participation in international/national scientific conferences of students and young scientists - 12 points;

- participation in national competitions in the discipline - 10 points

- participation in Olympiads and scientific conferences of KhNADU 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 assessed on a two-point scale (passed/not passed) according to Table 2;

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

**Table 2** - Scale of points conversion to the national evaluation system

On a 100-point scale	On the national scale		
from 60 points to 100 points	enrolled		
less than 60 points	unaccounted for		

 Table 3 - Scale for assessing the knowledge of students based on the results of the final control of the discipline

Score	Assessment on the national scale		Evaluation on the ECTS scale		
in points			Evaluation	Criteria.	
	examination	offset			
90- 100	That's great.	Enrolled	A	The theoretical content of the course is mastered completely, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided by the training program are completed, the quality of their implementation is estimated by the number of points close to the maximum	
80-89	Okay.	Enrolled	В	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 training tasks provided by the training program are completed, the quality of most of them is estimated by the number of points close to the maximum	

Score	Assessment	t on the		Evaluation on the ECTS scale
in	national scale		Evaluation	Criteria.
points	examination	offset		
75-79	CXAITIITATION		С	The theoretical content of the course is fully mastered, without gaps, some practical skills of working with the mastered material are insufficiently formed, all the training tasks provided by the curriculum are completed, the quality of any of them is not assessed by the minimum number of points, some types of tasks are performed with errors
67-74	factory		D	The theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills of working with the mastered material are basically formed, most of the training tasks provided by the curriculum are completed, some of the completed tasks may contain errors
60-66	Satist		E	The theoretical content of the course is partially mastered, some practical skills have not been 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	Unsatisfactory	t enrolled	FX	The theoretical content of the course is partially mastered, the necessary practical skills have not been formed, most of the learning tasks provided by the curriculum 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 learning tasks (with the possibility of repeating)
0-34	Unacceptable.	N	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 training tasks (with a mandatory repeated course)

# Policy of the course:

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

- mastering the discipline involves mandatory 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 provided by the program must be completed in due time;

- if the applicant for higher education is absent from classes for a valid reason, he/she presents the completed tasks during independent preparation and consultation of the teacher;

- while studying the course, higher education students must adhere to the rules of academic integrity set out in the following documents: "Rules of academic integrity of participants of the educational process of KNADU" (https://www.khadi.kharkov.ua/fileadmin/P\_Standart/pologeniya/stvnz\_67\_01\_dobroch\_1.p df), "Academic integrity. Checking the text of academic, scientific and qualification papers for

(https://www.khadi.kharkov.ua/fileadmin/P\_Standart/pologeniya/stvnz\_85\_1\_01.pdf),

"Moral and ethical code of participants of the educational process of KNADU (<u>https://www.khadi.kharkov.ua/fileadmin/P\_Standart/pologeniya/stvnz\_67\_01\_MEK\_1.pdf</u>). - in case of detection of the fact of plagiarism, the applicant receives 0 points for the

task and must repeat the tasks provided in the silabus;

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

# **Recommended literature:**

1.1 Zamikhovsky L.M. Fundamentals of the theory of reliability and technical diagnostics of systems: Textbook / L.M. Zamikhovsky, V.P. Kalyavin.- Ivano-Frankivsk: Polumya Publishing House, 2019.- 360 p.

1.2 Gavrylenko V.V. Fundamentals of reliability of computerized systems. Textbook / V.V. Gavrylenko, R.A. Serebryakov - K.: NTU, 2018. 214 p.

1.3 Reliability and diagnostics of electrical equipment: Textbook / O.V. Hubarevych. -Severodonetsk: V. Dahl National University Publishing House, 2016. - 248 p.

# Additional sources:

2.1 Kolisnyk M.O., Piskachova I.V. Reliability of software of microprocessor control devices of telecommunication systems: Study guide. - Kharkiv: UkrDAZT, 2012. - 167 p.

2.2 Salogub M.V. Electronic textbook on discipline: Reliability, diagnostics and operation of computer systems and networks. [Electronic resource]. - Access mode: https://mishchyk.files.wordpress.com/2020/03/nadiynist.pdf.

Developer silabus of the discipline\_\_\_\_

Serhiy ZAPOROZHTSEV name signature

Head of the Department

Oleksandr GURKO name signature