# Silabus educational component of the EC

(conventional designation of EC in the educational programme (EP))

Electric drive automation				
Name of the discipline:	Electric drive automation			
Level of higher education:	first (educational and scientific)			
Course page in Moodle:	https://dl.khadi.kharkov.ua/course/view.php?id=2327			
Scope of the educational	4 credits (120 hours)			
component				
Form of final control	Credit			
Consultations:	on schedule			
Name of the department:	Department of Automation and Computer-Integrated			
	Technologies			
Language of instruction:	Ukrainian			
Course leader:	Oleksandr Kononykhin, Associate Professor, PhD in			
	Engineering			
Contact phone number:	0996637295			
E-mail:	Alex.kon.akit@gmail.com			

### Summary of the educational component:

**The aim is to** provide students with the basics of analysing the general requirements for motion control of an electric drive and a production mechanism, studying the principles of construction and calculation methods for electric drive control systems, typical components and control elements of DC and AC electric drive systems.

**Subject:** theoretical and methodological foundations, methodological provisions of scientific directions of electric drive motion control and production mechanism, study of the principles of construction and calculation methods of electric drive control systems, typical components and control elements of DC and AC electric drive systems.

The main objectives of the discipline are:

Acquiring knowledge of the principles of construction, functional properties, basic laws of control of automated electromechanical systems and electric drives;

Acquiring the ability to justify the choice of a rational engineering solution, identify reserves for improving the efficiency of electric drive control, conduct an objective analysis of the properties of automated electric drives, and use a modern element base to improve the performance of electric drives;

Acquiring skills in the development, design, commissioning and research of automated electric drive systems; assessing the technical and economic efficiency of the control systems used, as well as choosing rational engineering solutions.

### Competences acquired by the applicant:

### General competencies:

Ability to apply knowledge in practical situations.

Ability to communicate in the state language both orally and in writing.

Skills in the use of information and communication technologies.

### Special (professional) competencies:

Ability to apply knowledge of mathematics to the extent necessary to use mathematical methods for the analysis and synthesis of automation systems.

Ability to apply knowledge of physics, electrical engineering, electronics and microprocessor technology to the extent necessary to understand processes in automation systems and computer-integrated technologies.

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

Ability to freely use modern computer and information technologies to solve professional problems, program and use applied and specialised computer-integrated environments to solve automation problems.

Learning outcomes:

Knowledge of linear and vector algebra, differential and integral calculus, functions of many variables, functional series, differential equations for functions of one and many variables, operational calculus, theory of functions of complex variable, probability theory and mathematical statistics, theory of random processes to the extent necessary to use mathematical apparatus and methods in the field of automation. Be able to apply modern information technologies and have the skills to develop algorithms and computer programs using high-level languages and object-oriented programming technologies, create databases and use Internet resources.

Understand the essence of the processes occurring in automation objects in the fields of instrumentation and automation of construction, road machinery and equipment, and be able to analyse automation objects and justify the choice of structure, algorithms and control schemes based on the results of the study of their properties

Be able to apply the methods of automatic control theory to the study, analysis and synthesis of automatic control systems.

To be able to apply methods of system analysis, modelling, identification and numerical methods to develop mathematical and simulation models of individual elements and automation systems as a whole, to analyse the quality of their functioning using the latest computer technologies.

Be able to use a variety of specialised software to solve typical engineering problems in the field of automation, including mathematical modelling, computer-aided design, database management, computer graphics methods.

### Learning outcomes in accordance with the study programme:

To create highly reliable automation systems with a high level of functional and information security of software and hardware.

To apply specialised conceptual knowledge, including modern scientific achievements, as well as critical understanding of modern problems in the field of automation and computer-integrated technologies to solve complex problems of professional activity.

To develop computer-integrated control systems for complex technological and organisational and technical objects, applying a systematic approach, taking into account non-technical components of the assessment of automation objects.

To develop functional, organisational, technical and information structures of automation systems for complex technological and organisational and technical objects, to develop software and hardware control systems using network and information technologies, industrial controllers, mechatronic components, robotic devices, human-machine interface tools and taking into account technological conditions and requirements for production management.

Adhere to the norms of academic integrity, know the basic legal norms for the protection of intellectual property, commercialisation of the results of research, invention and design activities.

Collect the necessary information using scientific and technical literature, databases and other sources, analyse and evaluate it.

#### Thematic plan

Topic No.Name of the topic (LC, PL, IL)hours face- to-facecorres ponde nce1LC Main types of drives for general industrial machinery21PL Modelling of control systems of the State Tax Service in MATLAB41IL Characteristics of general industrial drives10202LC Mechanics of a multi-mass system. Mechanical vibrations. Impacts in a mechanical system.22PL Modelling of the DPS start-up by time41L Logical and physical topologies. Logical structuring Networks. Bridges, switches, routers10253LC Cyclic and continuous actuators. Equivalent modes43PL Modelling of the DPS start-up by speed61< Electric drives for conveyors and escalators20204PL Modelling of the current start of the DPS61< LO principles of regulation of electric drives44PL Modelling of the current start of the DPS61LD ynamic properties of open-loop electromechanical systems.20			Number of		
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LC Generalised electromechanical converter 2		LC Generalised electromechanical converter	2		
5 PL Modelling of dynamic braking of the DPS 4	5	PL Modelling of dynamic braking of the DPS	4		
IL Dynamic properties of closed electromechanical systems 20 20		IL Dynamic properties of closed electromechanical systems	20	20	
LC Mathematical models of the main types of electromechanical		LC Mathematical models of the main types of electromechanical			
conversion (direct current, asynchronous motors, synchronous 2		conversion (direct current, asynchronous motors, synchronous			
motors)		motors)			
6 PL Modern software for the design of systems with electric 4	6	PL Modern software for the design of systems with electric	4		
drives		drives	0	20	
IL Practical Implementation of new technologies 9 20		IL Practical Implementation of new technologies	9	20	
Calculation and graphic work o			0		
LC 16		LC	16		
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her 12 120	her	HL IIL	72	120	

### Individual research assignment (if available):

### Teaching methods:

- verbal method (lecture, class discussion, explanation, story);

- practical method (practical classes, business and role-playing games, brainstorming);

- visual method (method of illustrations, method of demonstrations);

- work with literature (scientific literature; regulatory literature; search for information on the task);

- independent work;

Forms and methods of assessment

- final control (credit)

- oral control (conversation)
- test control
- practical examination (defence of practical works)
- methods of self-control and self-assessment

## Assessment system and requirements:

## Current performance

**1** The current academic performance of students for the performance of academic types of work in classrooms and for the performance of independent work is assessed using a fourpoint grading scale with the subsequent conversion to a 100-point scale. When assessing current performance, all types of work provided by the curriculum are taken into account.

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

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

**1.3** Laboratory classes are assessed by the quality of laboratory reports.

**1.4** Seminar classes are assessed by the quality of the individual assignment/report.

**2** Assessment of the current performance of higher education students is carried out at each practical lesson (laboratory or seminar) on a four-point scale ("5", "4", "F", "2") and is recorded in the academic record book.

- "excellent": the applicant has mastered the theoretical material flawlessly, demonstrates in-depth knowledge of the relevant topic or discipline, and the main provisions; - "good": the applicant has mastered the theoretical material well, knows the main aspects of the primary sources and recommended literature, presents it in an argumentative manner; has practical skills, expresses his/her views 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 familiar with the primary sources and recommended literature, but gives unconvincing answers, confuses concepts, is uncertain about answering additional questions, does not have stable knowledge; when answering practical questions, shows inaccurate 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 familiar with primary sources and recommended literature, lacks scientific thinking, and has not developed practical skills.

**3** The final grade for the current activity is recognised as the arithmetic mean of the grades for each class, individual work, and current tests 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, ..., Kn - Assessment of the success of the *n* current control measure; *n* - number of current control measures.

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

 Table 1 - Conversion of the average score for current activities to 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-examir	ation

## **Final assessment**

**1** The exam is conducted after studying all topics of the discipline and is taken by higher education students during the examination session after all classroom classes

**2** Higher education students who have completed all types of work provided for in the curriculum of the discipline are allowed to take the exam:

- attended all academic classes (lectures, seminars, and workshops);

- made up all missed classes in a timely manner;

- have scored a minimum number of points for current academic performance (at least 36 points, which corresponds to a 3 on the national scale);

If the current academic performance in the discipline is below 36 points, the higher education student has the opportunity to increase his or her current score to the minimum before the start of the examination session.

**3** The assessment of applicants' knowledge during the exam is carried out on a 100-point scale.

The assessment of applicants' knowledge through testing is carried out on a scale:

- "Excellent": at least 90% of correct answers;

- "Very good": 82% to 89% of correct answers;

- "Good": 74% to 81% of correct answers;

- Satisfactory: 67% to 73% of correct answers;

- "Satisfactory enough": 60% to 66% of correct answers;

- "Unsatisfactory": less than 60% of correct answers.

**4** The final grade in the discipline is determined as a weighted average grade that takes into account the overall grade for the current performance and the grade for the exam.

**5** The calculation of the total final grade for the discipline is carried out according to the formula:

$$\Pi K^{e_{\kappa_3}} = 0, 6 \cdot K^{nomo_4} + 0, 4 \cdot E'$$

where  $\Pi K^{e_{\kappa_3}}$  is the final grade in the disciplines for which the form of final control is an examination;

 $K^{nomov}$  - final performance assessment based on the results of the current control (on a 100-point scale);

*E* - grade based on the results of the exam (on a 100-point scale).

0.6 i 0.4 - coefficients of the ratio of points for the current academic performance and

the exam.

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

**6.1** Additional points are added to the sum of points gained by the higher education student for the current academic activity (for disciplines for which the final form of control is a test), or to the final grade in the discipline for which the final form of control is an examination.

**6.2 The** number of additional points awarded for different types of individual tasks depends on their scope and significance:

- prize-winning places in the discipline at the international/national competition of student research papers - 20 points;

- prize-winning places in the discipline at 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 all-Ukrainian competitions in the discipline - 10 points

- participation in competitions and scientific conferences of KhNADU in the discipline - 5 points;

- completion of individual research (educational and research) tasks of increased complexity - 5 points.

6.3 The number of additional points cannot exceed 20 points.

7 The total final grade for the discipline cannot exceed 100 points.

The total final grade for the discipline is determined according to the scale given in Table 2.

**Table 2** - Scale for assessing students' knowledge based on the results of the final control in the discipline

Score	Score on the	national	ECTS grades		
in points	scale		Assessment.	Criteria.	
ponno	examination offset				
90- 100	Excellent	Enrol led	A	The theoretical content of the course has been mastered in full, without gaps, the necessary practical skills to work with the material have been formed, all the learning tasks provided for in the curriculum have been completed, the quality of their performance has been assessed with a number of points close to the maximum	
80-89	Good.	Enrol led	В	The theoretical content of the course has been mastered in full, without gaps, the necessary practical skills to work with the material have been basically formed, all the learning tasks provided for in the curriculum have been completed, the quality of most of them has been assessed with a number of points close to the maximum	

Score	Score on the	national	ECTS grades		
in	scale		Assessment.	Criteria.	
points	examination	offect			
75-79	examination	Unset	С	The theoretical content of the course is	
				mastered in full, without gaps, some practical skills of working with the material mastered are insufficiently developed, all the learning tasks provided for by the curriculum have been completed, the quality of any of them is not assessed with the minimum number of points, some types of tasks are completed with errors	
67-74	Satisfacto ry		D	The theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills to work with the material mastered are basically formed, most of the learning tasks provided for in the curriculum have been completed, some of the completed tasks may contain errors	
60-66			E	The theoretical content of the course is partially mastered, some practical skills have not been developed, many of the learning tasks provided for in the curriculum have not been completed, or the quality of some of them is assessed with a score close to the minimum.	
35-59	Unsatisfa ctory	Not credit ed	FX	The theoretical content of the course is partially mastered, the necessary practical skills have not been formed, most of the assignments provided by the curriculum have not been completed, or the quality of their performance is assessed with a score close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the assignments (with the possibility of retaking)	

Score	Score on the national		ECTS grades		
ın points	scale	scale		Criteria.	
•	examination	offset			
0-34	Unaccept able		F	The theoretical content of the course is not mastered, the necessary practical skills are not formed, all completed assignments contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the assignments (with a mandatory repeated course)	

## **Course policy:**

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

- mastering the discipline requires mandatory attendance at 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 programme for independent study, or have been considered briefly;

- all tasks envisaged by the programme must be completed on time;

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

- the term paper must be defended no later than one week before the start of the examination session *(if available)*;

- 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 in the Educational Process of KhNADU" (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 works for plagiarism"

(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 KhNADU (https://www.khadi.kharkov.ua/fileadmin/P Standart/pologeniya/stvnz 67 01 MEK 1.pdf). - if the fact of plagiarism is detected, the applicant receives 0 points for the assignment and

- If the fact of plagiarism is detected, the applicant receives 0 points for the assignment and must repeat the tasks provided for in the silent study;

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

Recommended reading: (literature no later than 10 years old, except for 1 fundamental classical textbook or monograph)

1. Bakhovets B.O. Automated electric drive: a textbook / B.O. Bakhovets - Rivne: NUVGP, 2020. 238 c.

2. Popovich M.G. et al. Electromechanical automatic control systems and electric drives: Study guide. - K.: Lybid, 2015. 680 c.

3. Kolb A.A., Kolb A.A. Theory of electric drive: A textbook. - Д.: NSU, 2016. 511 с.

4. Palmer M., Sinclair R.B. Design and Implementation of Computer Networks. Training course, 2017 - 164c.5. Sinyavsky O.Y., Savchenko V.V., Lavrinenko Y.M., Voytyuk D.G.,

Bunko V.Y., Ramsh V.Y.. Electric drive of production machines and mechanisms: Edited by O.Y. Sinyavsky - K.: FOP Yamchynsky O.V. 2020. 444c.

6. Analysis of Electric Machinery and Drive Systems, Second Edition, by Krause, Wasynczuk, Sudhoff. IEEE Press / Wiley Inter-Science, West Lofayette, Indiana November 2015. Page-632.

### Additional sources:

1. distance learning course:

https://dl.khadi.kharkov.ua/course/view.php?id=2327

Developer(s)

educational course syllabus

O. Kononykhin

Department Chair

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