Syllabus of the educational component ED

Programming real-time systems

Name of the discipline:	Programming real-time systems
Level of higher education:	first (educational)
Course homepage in Moodle:	https://dl2022.khadi-kh.com/course/view.php?id=902
Academic workload	3 credits (90 hours)
Form of summative	credit test
assessment	
Consultations:	on schedule
Name of the department:	Automation and computer-integrated technologies
Language of instruction:	the english language
Course leader:	Nataliia Fil, PhD, Associate Professor
Contact phone number:	(068)617-76-94
E-mail:	fil_nu@i.ua

Summary of the educational component:

The aim is to develop the competences necessary for the development, use and user applications for programmable logic controllers in the languages of the international IEC 61131-3LD, FBD, IL, ST, SFC standards.

Subject: pedagogically adapted system of concepts about programming logic controllers in the languages of the international standard IEC 61131-3LD, FBD, IL, ST, SFC.

The main objectives of the discipline are:

-familiarising students with the international standard IEC61131-3, its general

- -elements, syntax of programming languages LD, FBD, IL, ST, SFC, tools
- -PLC programming, methods of creating user applications in systems
- -programming for PLCs.

Prerequisites for studying the educational component:

Computer science; Fundamentals of electrical engineering and electronics

Competences acquired by the applicant:

General competencies:

Ability to apply knowledge in practical situations and justify decisions.

Skills in the use of information and communication technologies

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

Knowledge and understanding of the subject area and understanding of professional activities.

Special (professional) competencies:

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 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 in accordance with the study programme:

Be able to apply modern information technologies and have the skills to develop algorithms and computer programs using high-level languages and use Internet resources.

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, computer graphics methods.

Thematic plan						
		Number of				
Topic No.		hours				
	Name of the topic (LC, PC, IW)	face	corres			
		lace-	ponde			
		to-race	nce			
1	2	3	4			
	LC Definition and main features of real-time systems	2	2			
	PC. Project development in FBD language	2	-			
1	IW The main stages of development of real-time information and					
	control systems. The current level of development of real-time					
	systems.	7	11			
	LC Kernels and real-time operating systems	2	-			
2	PC Project development in FBD language	2	-			
	IW Examples of typical real-time systems.	7	11			
	LC Processes, flows, tasks	2	-			
3	PC Development of projects in LD language	2	-			
	IW Process control in real-time systems	7	11			
	LC Real-time task dispatching algorithms	2	-			
	PC Creating a project in the ST language	2	-			
4	IW Process management: scheduler (changing the state and					
	forming the current priority), dispatcher (selecting the process to					
	be executed).	7	11			
	LC Organisation of interaction between processes					
5	PC Create a project in the SFC language	2	-			
	IW Features of software configuration in real-time systems	7	11			
	LC POSIX standards for real-time applications					
6	PC Development of an application in SFC that implements the					
0	control algorithm	2	-			
	IW Real-time systems life cycle	7	11			
	LC. QNX platform	2	-			
7	PC Development of an application in SFC that implements the					
	control algorithm	2	-			
	IW Modern functionality of the QNX platform	7	11			
	LC. Visual modelling and design of real-time software systems	2	-			
8	PC Analogue signal processing with the ISAGRAF function	2	-			
	IW Programming languages for industrial controllers. Real-Time					
	Java platform	9	11			
Togoth	LC	16	2			
or	PC	16				
	IW	58	88			
Togethe	90	90				

* LC – lecture classes, PC – practical classes, IW – individual work

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

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

Evaluation system and requirements:

Current academic performance

1 The current performance of applicants for the performance of educational types of work in practical classes and for the performance of independent work tasks is evaluated 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 applicants of the first (bachelor's) level is carried out at each practical lesson on a four-point scale ("5", "4", "3", "2") and recorded in the academic record.

- "excellent": the applicant has flawlessly mastered the theoretical material, demonstrates deep 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;

- "average" 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;

- "below average": 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:

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

where K^{curret} is the total formative score obtained based on the results of the formative assessment;

K1, K2, ..., Kn is the score for the nth formative assessment assignment;

n is the number of current control measures.

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

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
						retakir	ng
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	retaking	

 Table 1 - Conversion of the average grade for a formative assessment assignment into a multi-point scale

Summative assessment

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 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;

- 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 evaluated (select the appropriate one):

- on a two-point scale (passed/not passed) according to Table 2;

- on a 100-point scale (for differentiated scoring) according to Table 3.

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

 Table 2 - Scale for assessing the knowledge of applicants based on the results of the final control of the discipline

Score	e Assessment according to thenational scale		Assessment according to the ECTS Grading Scale		
			Grade	Criteria	
	examination	offset			
90- 100	Excellent	Passed	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 course assignments are completed, the quality of most of them is estimated by the number of points close to maximum	
80-89	Good	be	В	The theoretical content of the course is mastered completely, without gaps, the necessary practical skills of working with the mastered material are mainly formed, all course assignments are completed, the quality of most of them is estimated by the number of points close to maximum	
75-79		Pass	С	The theoretical content of the course is mastered completely, without gaps, some practical skills of working with the mastered material are insufficiently formed, all course assignments 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	

Score	Score Assessment according to thenational scale		Assessment according to the ECTS Grading Scale		
			Grade	Criteria	
	examination	offset			
67-74	erage		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 course assignments are completed, some of them contain errors	
60-66	Av		E	The theoretical content of the course is partially mastered, some practical skills are not formed, many of the course assignments are not completed, or the quality of some of them is estimated by the number of points close to minimum	
35-59	Below average	Failed	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	Failing		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)	

Course policy:

- the course implies 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 individual work;

- individual work involves studying certain topics of the academic discipline that are assigned for individual study or considered briefly;

- all course assignment must be completed on time;

- if a higher education applicant does not attend classes for a valid reason, they present the completed assignments performed during their individual work at the consultation with the teacher;

- while studying the course, higher education applicants must adhere to the rules of academic integrity set out in the following documents: "Rules of academic integrity for participants in the educational process at 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 andqualification works for plagiarism"

(<u>https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85_1_01.pdf</u>, "Code of ethics for participants in the educational process at KNADU" (<u>https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf</u>).

Recommended literature:

1. Basic

- Zaitsev, V. G. Real-time computer systems: a textbook for master's degree students in the educational programme "System programming and specialised computer systems", speciality 123 "Computer engineering" / V. G. Zaitsev, E. I. Tsybaev - Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2019. 162 p. [Access mode: https://ela.kpi.ua/handle/123456789/29604.
- 2. Programming of industrial controllers in the UnityPro environment: Study guide K.: Lira-K Publishing House, 2021. 376 p.
- 3. Gren Y. V. Programming of real-time systems: a textbook Lviv: Lviv Polytechnic, 2011. 324 c.
- Nikolayenko A.M. PLC programming in Softlogic-system KWMULTIPROG: a textbook. [for students of higher educational institutions] / Nikolayenko A.M. -Zaporizhzhya: Izd. ZGIA, 2008. 203 p.
- 5. Fil N.Y. Methodical instructions for practical work in the discipline "Programming of real-time systems" for students of speciality 151 "Automation and computer-integrated technologies". Kharkiv: KhNADU. 2021 56 p.

2. Supplementary and iformation resources:

- 1. Distance learning course: <u>https://dl2022.khadi-kh.com/course/view.php?id=902</u>
- 2. http://vdt-automation.com.ua/
- 3. http www schneider electric ua
- 4. http://www.technolink.net/ua/
- 5. http://www.indsoft.com/ua/
- 6. National Instrument: What is a Real-Time Operating System (RTOS)? [Electronic resource]. Access mode: http://www.ni.com/white-paper/3938/en.

Developer(s)

the silhouette of the discipline

<u>Natalia FIL</u>

Head of the Department

Oleksandr GURKO