Syllabus VK Real-time operating systems

Subjects:	Real-time operating systems
Level of higher education:	first (undergraduate)
Course page in Moodle:	https://dl2022.khadi-kh.com/course/index.php?categoryid=39
The scope of the	3 credits (90 hours)
educational	
component	
Final control form	Test
Consultations:	on schedule
Name of the department:	department of computer technologies and
	mechatronics
Teaching language:	English
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Brief content of the educational component:

The goal is formation of students' scientifically based approach to principles

working of real-time operating systems, mastering the skills of computer system resource management, its configuration and reasoned choice of an operating system to solve certain tasks.

Subject:real-time operating systems, hardware and software mechanisms for real-time provisioning, primitives of synchronization and interprocessor interaction of tasks and methods of analyzing the dispatchability of software systems.

The main tasks of studying the academic disciplinestudy of the main aspects and principles of operation of real-time operating systems.

Prerequisites for studying the educational component:

Basics of information technologies;

Architecture of computer systems.

Competencies acquired by the acquirer:

General competences:

- Ability to apply knowledge in practice;
- Ability to solve tasks and make appropriate decisions;

 Ability to create system and application software for computer systems and networks;

 Ability to systematically administer, use, adapt and operate existing information technologies and systems;

- Know the basics of professionally oriented disciplines of the specialty;

Special competences:

- The ability to accumulate, process and systematize professional knowledge about creating and maintaining software and recognizing the importance of lifelong learning;

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

 Be able to think systematically and apply creative abilities to the formation of fundamentally new ideas;

- Be able to develop software for embedded and distributed applications, mobile and hybrid systems, calculate, operate equipment typical for the specialty.

Learning outcomes according to the educational program:

- Know and apply in practice the fundamental concepts, paradigms and basic principles of the functioning of linguistic, instrumental and computing tools of software engineering.

- Conduct a pre-project survey of the subject area, system analysis of the design object.

- Select input data for design, guided by formal requirements description and modeling methods.

- Know and be able to apply information technologies for data processing, storage and transmission.

Topic No		Number of hours	
	Name of topics (LK, LR, PR, SZ, SR)	ocular	extramural
1	Lecture #1: The main features of real-time systems: the concept of "real-time", "work on a real-time scale", "real-time operating systems".	2	
	Practical lesson 1	2	
	Tasks for independent work 1	7	
2	Lecture #2: Basic provision of real-time operating systems.	2	
	Practical lesson 2	2	
	Assignment for independent work 2	7	
3	Lecture #3: Overview of architectures of real-time opration systems.	2	
	Practical lesson 3	2	
	Assignment for independent work 3	7	
4	Lecture #4: Flows and processes of real- time operating systems. Exchange of information between processes.	2	
Practical lesson 4		2	
	Assignment for independent work 4	7	
5	Lecture #5: Overview of modern real-time appraisal systems and their scope of application.	2	
	Practical lesson 5	2	
	Assignment for independent work 5	7	
6	Lecture #6: Overview of the QNX real-time operating system. History of development and use of the QNX system.	2	
	Practical lesson 6	2	
	Assignment for independent work 6	7	
7	Lecture #7: QNX system architecture and programming basics.	2	
Practical lesson 7		2	
	Assignment for independent work 7	7	
8	Lecture #8: Dispatching of flows in real time.	2	

Thematic plan

	Practical lesson 8	2	
	Assignment for independent work 8	9	
Together	Lectures	16	
	Practices	16	
	Independent work	58	

Individual educational and research task: not provided.

Teaching methods:

1) verbal: 1.1 traditional: lectures, explanations, stories, 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): trainings, "round table", brainstorming method.

Evaluation system and requirements:

The concretization and detailing of the criteria and evaluation system, taking into account the specifics of the educational component, is carried out on the basis of the general criteria specified in STVNZ 7.1-02:2018 "Regulations on the Organization of the Educational Process at the Khnadu" (https://www.khadi.kharkov.ua/fileadmin/P_Ychebotdel/norm_dok/stvnz_7_1_02.pdf) and STVNZ 90.1-01:2021 "Evaluation of learning outcomes of higher education applicants" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz-90.1-01_2021.pdf).

Current performance

1 The current success of applicants for the performance of educational types of work in training sessions and for the performance of independent work tasks is evaluated using a four-point rating scale with subsequent transfer to a 100-point scale. During the evaluation of the current performance inare countedall types of work provided by the curriculumprogram

1.1 Lectures occupationare evaluated by definition quality implementation of specified tasks

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

- **1.3** Laboratory occupation are evaluated quality
- implementation reports about implementationlaboratory work.
- **1.4** Seminary occupation are evaluated quality implementation individualassignment/abstract.

2 Evaluation of the current success rate of higher education applicants is carried out at each practical session(laboratoryor seminary) on a four-point scale("5", "4", "Z", "2")and are enteredinaccounting journalacademicsuccess

 – "excellent": acquirerflawlessly mastered the theoretical material, demonstrates deepknowledge of relevant topic or academic discipline, main provisions;

– "good": the applicant has mastered the theoretical material well, possesses the main aspects from primary sources and recommended literature, presents it in a reasoned way; has practical skills, expresses his thoughts on certain problems, but certain inaccuracies and errors are assumed in the logic of the presentation of theoretical content or in the analysis of practical ones;

- "satisfactory": the applicant has basically mastered the theoretical knowledge of the educational topic or discipline, orients himself in primary sources and recommended literature, but answers unconvincingly, confuses concepts, answers additional questions uncertainly, does not have stable knowledge; when answering questions of a practical nature, reveals inaccuracy in knowledge, does not know how to evaluate facts and phenomena, connect them with the future profession;

 "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, hardly orients himself in primary sources and recommended literature, lacks scientific thinking, practical skills are not formed.

3 Final scorebycurrent activity is recognized as an arithmetic averagesumpoints for each lesson, for individual work, current control works according to the formula:

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

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

K1, K2, ..., Kn- evaluation of success*n*-th measure of current control;

n- the number of measures of current control.

Grades are converted inpoints according to the calculation scale (table 1).

100-100-100-4-point 4-point 4-point 4-point 100-point point point point scale scale scale scale scale scale scale scale 5 4.45 89 3.90 3.35 100 78 67 4.95 99 3.85 3.3 4.4 88 77 66 4.9 98 4.35 87 3.80 76 3.25 65 4.85 97 75 64 4.3 86 3.75 3.2 4.8 96 4.25 3.7 74 3.15 63 85 4.75 95 4.20 3.65 73 62 84 3.1 4.7 4.15 72 3.05 61 94 83 3.60 4.65 93 4.10 82 3.55 71 3 60 92 4.05 70 from 1.78 to 4.6 81 3.5 from 35 to 2.99 59 reassembly 91 80 3.45 69 from 0 to 1.77 from 0 to 34 4.55 4.00 4.5 90 3.95 79 3,4 68 repeated study

 Table 1– Recalculation of the average grade for the current activity into a multipoint scale

Final assessment

1 The exam is held after studyingeveryonetopics of the discipline and is composed of students of higher education during the examination session after the end of all classroom classes

2 Applicants of higher education who have completed all types of work prescribed by the curriculum in the discipline are admitted to the exam:

- were present ateveryoneclassroom classes (lectures, seminars, practical);
- completed all missed classes on time;

- scored the minimum number of points for the current academic performance (at least 60 points, which responds n a national scale"3");

If the current performance in the discipline is lower than 60 points, the higher education applicant has the opportunity to increase his current point to the minimum before the beginning of the examination session.

3 Assessment of the knowledge of applicants when taking the exam is carried out on

a 100-point scale.

Assessment of the knowledge of applicants through testing is carried out according to the following scale:

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

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

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

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

- "Fair enough": 60% to 66% correct answers;

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

4 The final grade for the academic discipline is defined as a weighted average grade that takes into account the overall grade for the current academic performance and the grade for passing the exam.

5 The calculation of the overall final grade for the study of an academic discipline is carried out according to the formula:

PKekz=0.6·Kpotoch+0.4·IS,

where PC^{ex} - final assessment of success in disciplines, in the form of a final report controls for which there is an exam;

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

IS- assessment based on the results of the exam (on a 100-point scale).

0.6 and 0.4

- coefficients of the ratio of points for current success and taking the exam.

6 For performing individual independent work and participating in scientific events, winners are awarded additional points.

6.1 Additional points are added to the total points scoredcakeof higher education for the current educational activity (for disciplines for which the final form of control is a credit), or to the final assessmentwithdisciplines, the final form of control for which is an exam.

6.2 The number of additional points awarded for different types of individual tasks depends on their volume and importance:

 prizes in the discipline at the international / all-Ukrainian competition of scientific student works - 20 points;

- prize places 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 the Khnadu in the discipline - 5 points;

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

6.3 The number of additional points cannot exceed 20 points.

7 General final rating by study educational disciplines not maybeexceed 100 points.

The overall final grade for the study of the academic discipline is determined according to the scale given in Table 2.

Table 2 The scale for evaluating the knowledge of the students based on the results of the final control of the academic discipline

Score	Asses	ssment	Evaluation according to the ECTS scale	
in	by national		Rating	Criteria
points	evaminat	test		
	ion	1031		
90-100	Perfectly	Enrolled	A	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have been formed, all the educational tasks provided for in the training program have been completed, the quality of their performance has been assessed by the number of points close to to the maximum
80-89	Okay	Okay Enrolled	В	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have mainly been formed, all educational tasks provided for in the training program have been completed, the quality of most of them has been evaluated with a number of points close to the maximum
75-79			WITH	The theoretical content of the course has been mastered completely, without gaps, some practical skills of working with the mastered material have not been sufficiently developed, all the educational tasks provided for by the training program have been completed, the quality of none of them has been evaluated with a minimum number of points, some types tasks were completed with errors
67-74	Ictorily	ctorily illed	D	The theoretical content of the course is partially mastered, but the gaps are not of a significant nature, the necessary practical skills for working with the mastered material are basically formed, most of the educational tasks provided by the training program have been completed, some of the completed tasks, may contain errors
60–66	Satisfa Enro	E	The theoretical content of the course has been partially mastered, some practical work skills have not been formed, many of the educational tasks provided by the training program have not been completed, or the quality of some of them has been assessed with a number of points close to minimal	

35–59	Unsatisfactorily		FX	The theoretical content of the course has been partially mastered, the necessary practical work skills have not been formed, most of the prescribed training programs of educational tasks have not been completed, or the quality of their implementation has been assessed with a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the performance of educational tasks (with the possibility of repeated drafting)
0–34	Unacceptable	Not counted	F	The theoretical content of the course has not been mastered, the necessary practical work skills have not been formed, all completed educational tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the performance of educational tasks (with a mandatory repeat course)

Course policy:

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

- mastering the discipline involves mandatory attendance at lectures and practical classes, as well as independent work;

- independent work involves the study of individual topics of the academic discipline, which are presented in accordance with the program for independent study, or were considered briefly;

- all tasks provided by the program must be completed within the set time;

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

- course work must be protected no later than a week before the beginning of the examination session;

- while studying the course, students of higher education must adhere to the rules of academic integrity set forth in the following documents: "Rules of Academic Integrity

participants educational process LOOKING

FOR"(<u>https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobro</u> <u>ch_1.p_df</u>), "Academic Integrity. Verification of academic, scientific and qualification texts on

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 the National Academy of Sciences (<u>https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.</u>

<u>pdf</u>).
 – in case of detection of plagiarism, the applicant receives 0 points for the task and must repeat the tasks provided for in the syllabus;

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

Recommended Books:

1. Juan Rivas, Joel Goossens, Xavier Poczekajlo, Antonio Paolillo. Implementation of memory centric scheduling for COTS multi-core real-time systems. In Proceedings of the 31st Euromicro Conference on Real-time Systems. 2019.

2. Federico Reghenzani, Glueppe Massari, William Fornaclari. The real-time Linux kernel: A survey on Preempt RT. ACM Computing Surveys. Volume 52, Issue 1, February 2019.

3. Marko Bertogna. High-Performance Real-time Architectures for Low-Power Embedded Systems. H2020-EU.2.1.1. Project Website:https://cordis.europa.eu/project/rcn/199161/factsheet/en. 2016-2018.

Additional sources:

1. Antonio Paoillo, Oliver Dersenfans, Vladimir Svoboda, Joel Goossens, Ben Rodriguez. A New configurable and parallel embedded real-time micro-kernel for multi-core platforms. In Proceedings of the ECRTS Workshop on Operating Systems Platforms for Embedded Real-Time applications (ECRTSOSPERT'15), July 2015.

2. Sukhyun Seo, Junsu Kim, Su Min Kim. An analysis of embedded operating systems: Windows CE, Linux, VxWorks, uC/OS-II, and OSEK/VDX. Journal of Applied Engineering Research, Vol. 12, No. 18, pp. 7976-7981, 2017.

3. Nisar Ahmed. Understanding real time OS concepts. International Journal of Scientific Engineering Research. Volume 6, Issue 9, pp. 67-70, September 2015.

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