

O. M. BEKETOV NATIONAL UNIVERSITY OF URBAN ECONOMY IN KHARKIV

Educational and Scientific Institute of Energy, Information and Transport Infrastructure

APPROVED

Director of the ESIEITI

(Igor BILETSKY)

2021



WORK PROGRAMME OF THE ACADEMIC DISCIPLINE

Architecture of Computer Systems


type of discipline, code for EP	<i>Compulsory, RC17</i>
semester	<i>semester number 3</i>
number of ECTS credits	<i>4</i>
form of final control	<i>exam</i>
language of instruction, teaching and assessment	<i>English</i>
department	<i>Computer Science and Information Technology</i>

for higher education applicants:

level of higher education	<i>first (bachelor's degree)</i>
branch of knowledge	<i>12 Information Technology</i>
specialty	<i>122 Computer Science</i>
educational programme	<i>Computer Science</i>
form of study	<i>full-time</i>

2021 – 2022 ACADEMIC YEAR

Developers:

Surname and initials	Position, email	Scientific degree, academic title	Signature
Anatoliy LITVINOV	Professor, Anatoliy.Litvinov@kname.edu.ua	d.t.s., professor	

The work programme was approved **at the proceedings** of the Department Computer Science and Information Technology

Minutes dated « 30 » august 2021 No.2

Head of the Department _____  (Maryna NOVOZHYLOVA)

The work programme of the discipline corresponds to the Educational Programme: Computer Science

Guarantor of the Educational Programme _____  (Mykola PAN)

1. The purpose of the discipline

The purpose of studying the discipline is to master the necessary knowledge on the basics of the theory of construction and functioning of the architecture of modern computer technology, made on the basis of integral technology, the formation of solid practical skills in assessing the technical state of computer technology, analysis of the conditions of functioning and synthesis of systems with given characteristics.

2. Interdisciplinary connections

The study of this discipline is directly based on: "Higher Mathematics", "Physics"

3. Learning outcomes

Programme learning outcome	Teaching methods	Forms of evaluation	Learning outcomes of the discipline
LO15 Understand the concept of information security, principles of secure software design, ensure the security of computer networks in conditions of incompleteness and uncertainty of the source data	Verbal, visual, practical	Oral survey, testing in Moodle, practical testing of skills, oral defence of laboratory reports. Individual task defence. Exam (in writing with tickets)	Know the basics of Boolean algebra. Know the structure of modern computers' processors. Know the internal interfaces of the motherboard. Have the skills to establish technical means of information systems. Know the external devices of computer systems. Know the communication devices with the object. Be able to calculate combinational circuits. To be able to choose technical means for creating nodes of computers.

4. Programme of the discipline

Module 1 Architecture of Computer Systems

Content module 1 Computer circuitry

The basic elements AND, OR, NOT are considered, on the basis of which the nodes of computer systems are built. The concept of a truth table is introduced, with the help of which the functioning of computer blocks is described. Part of the module's material is devoted to triggers and nodes from which they are built. The schemes of construction and functioning of encoders, decoders, multiplexers and demultiplexers are considered.

Content module 2 Computer architecture

Modern computers are built on a modular basis. A typical scheme of a computer system developed by von Neumann is considered. A simplified diagram of the processor

and the purpose of its main units are presented. The ways to improve the performance of computer systems are considered.

Content module 3 External devices of computers

The main external devices of a computer system and the principles of their construction and functioning are considered. The main models and approximate prices for them are given. The concept of an interface is introduced and the main interfaces through which external devices are connected to a computer are considered. A typical scheme for constructing a digital control system for a production facility based on a computer is presented. The schemes of construction and principles of functioning of the main communication devices with the control object are considered.

5. Structure of the discipline and distribution of time

Content modules	Number of hours				
	total	lectures	practice	lab	independent work
MODULE (semester 3)	120	15	30	15	60
Content module 1	30	6	12	5	7
Content module 2	30	6	12	6	6
Content module 3	15	3	6	4	2
Individual task	30				30
Final control	15				15

6. Themes of the lectures

Theme	Contents (plan)	Number of aud. hours
Content module 1		
Digital computers	The history of the development and generation of computers. The principle of the computer. Number systems. Boolean algebra. Karnot map. Basic elements of computer systems.	2
Computer system processors	Typical processor scheme. Processor motherboard. Arithmetic- logical device of a processor. Processor control device. Ways to improve processor performance. Modern processors of computer systems. Multiprocessor systems.	2
Computer interrupt systems	The purpose of the computer interrupt system. Organization of the computer interrupt system. Disciplines for servicing interrupt requests. Multichannel priority devices. Serving interrupt requests on the "Daisy chain". Hardware implementation of	2

	disciplines FIFO, LIFO, with dynamic priority.	
Content module 2		
Random access memory of computer systems	Purpose of random access memory. Physical implementation of devices for storing a bit of information. RAM implementation technology. Memory management systems of computer systems. Memory protection systems.	2
External memory of computer systems	Organization of external memory. External hard disk storage; design and characteristics of the hard drive. File systems FAT32 and NTFS. Solid state storage devices (SSD drives). Optical storage devices.	2
Internal and external interfaces of computer systems	Assignment of internal and external interfaces. SATA interface and its varieties. PCI and PCI Express interfaces. VGA, DVI, HDMI monitor interfaces and their characteristics. Universal USB interface, its characteristics and varieties. Network interfaces of computer systems	2
Content module 3		
Input-output devices of computer systems	Purpose and principle of work of a keyboard. Purpose and types of computer mice. The main characteristics of a computer mouse. Purpose, characteristics and classification of monitors. Types of monitors (LCD, TFT, plasma, projection, OLED monitors). Characteristics of monitors. Monitor interfaces. Types of printers and their characteristics. Laser printers. LED printers. Inkjet printers. 3D printers. Purpose of scanners, principle of operation and their varieties. Characteristics of scanners.	2
Object communication devices	The general structure of the computer communication system with a control object. Analog-to-digital converters, characteristics, principle of operation, varieties. Digital-to-analog converters, characteristics, principle of operation,	2

	varieties. Pulse number input module.	
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7.1 Themes of the practical classes

Theme	Contents (plan)	Number of aud. hours
Content module 1		
Technology for converting numbers from one number system to another	Theoretical part: converting numbers from one positional number system to another translation of correct crushers from one positional number system to another; converting binary, octal, and hexadecimal numbers to decimal Practical lesson assignment Control questions	4
Performing addition and subtraction operations on a computer	Theoretical part: representation of numbers in a computer in two's code; adding two's complement numbers Practical lesson assignment Control questions	2
Convert numbers from decimal to binary in floating point format in normalized form	Theoretical part: fixed point numbers; floating point numbers. Practical lesson assignment Control questions	4
Content module 2		
Combination circuit design	Theoretical part boolean functions The concept of the Karnot map Determination of algebraic expressions of Boolean functions by the Carnot chart Using Boolean Functions in Digital Hardware Practical lesson assignment Control questions	4
Boolean functions using to encrypt text	Theoretical part Basic cryptography concepts Encoding text information Cryptosystems based on humility Using Boolean Functions in Digital Hardware Assignment for a practical lesson, the	4

	<p>procedure for its implementation and execution</p> <p>An example of solving task</p> <p>Control questions</p>	
Design of counters	<p>Theoretical part: counters, their types and schemes construction; counters design technology</p> <p>Practical lesson assignment</p> <p>Control questions</p>	4
Content module 3		
Optimal design of the structure of a local computer network	<p>Purpose of the lesson</p> <p>Theoretical part: a discrete programming model of the LCN information structure, its algorithmic and software implementation; method of potentials for calculating the shortest distances between network nodes</p> <p>Practical lesson assignment</p> <p>Control questions and tasks</p>	4
Designing of Mealy and Moore Automata	<p>Theoretical part: graph diagram of a digital automaton; building of digital automata on the hardware level</p> <p>Practical lesson assignment</p> <p>Control questions</p>	

7.2 Themes of the laboratory classes

Theme	Contents (plan)	Number of aud. hours
Content module 1		
Researching of computer systems triggers	<p>Purpose and program of work</p> <p>Brief theoretical information</p> <p>Work order</p> <p>Control questions and tasks</p>	1
Study of the functioning of the power supply unit of stationary computers	<p>Purpose and program of work</p> <p>Brief theoretical information</p> <p>Work order</p> <p>Control questions and tasks</p>	2
Study of logic circuits and memory circuits on diodes and transistors	<p>Purpose and program of work</p> <p>Brief theoretical information</p> <p>Work order</p> <p>Control questions and tasks</p>	2

Content module 2		
Research of computer systems triggers	Purpose and program of work Brief theoretical information Work order Control questions and tasks	2
Research of USB interface	Purpose and program of work Brief theoretical information Work order Control questions and tasks	2
Construction and research of counters	Purpose and program of work Brief theoretical information Work order Control questions and tasks	2
Content module 3		
Computer technology at the register level	Purpose and program of work Brief theoretical information Work order Control questions and tasks	2
Research of arithmetic-logical device	Purpose and program of work Brief theoretical information Work order Control questions and tasks	2

8. Individual task (IT)

Kind: calculation and graphic work

Name: development and optimization of the computer system module

Aim: the acquisition of skills in the design of individual nodes of a computer system.

9. Methods of control and the procedure for assessing learning outcomes

Structure of the discipline and distribution of points

Content modules	Maximum number of points			
	total	practice	lab	independent work
MODULE (semester)	100			
Content module 1	20	10	5	5
Content module 2	20	10	5	5
Content module 3	20	10	5	5
Individual task	10			10
Final control	30			

Types of the tasks, means of control and maximum number of points

Types of the tasks and means of control (<i>testing, control works, individual tasks, reports on laboratory classes, etc.</i>)	Distribution of points
Content module 1	20
Laboratory work "Introduction to Electronic Circuit Simulation Systems Electronics Workbench" (report from work, defence)	1
Practical exercise "Technology for converting numbers from one number system to another" (calculation performed on the assignment, oral questioning)	3
Laboratory work "Study of the functioning of the power supply unit of stationary computers" (report from work, defence)	2
Practical exercise "Performing operations of addition and subtraction in a computer" (calculation performed on the task, oral questioning)	3
Laboratory work "Study of logic circuits and memory circuits on diodes and transistors" (report from work, defence)	2
Practical exercise "Converting numbers from decimal to binary in floating point format in normalized form" (calculation performed on the assignment, oral questioning)	4
Tasks for independent work "Review of modern processors" (report from work, protection)	3
Test on theoretical material (test in Moodle)	2
Content module 2	20
Laboratory work «Research of computer systems triggers» (report from work, defence)	1
Practical exercise "Combination circuit design" (calculation performed on the assignment, oral questioning)	3
Laboratory work «Research of USB interface» (report from work, defence)	2
Practical exercise «Boolean functions using to encrypt text» (calculation performed on the assignment, oral questioning)	3
Laboratory work «Construction and research of counters» (report from work, defence)	2
Practical exercise «Design of counters» (calculation performed on the assignment, oral questioning)	4
Tasks for independent work «Overview of wireless interfaces»" (report on operation, defence)	3
Test on theoretical material (test in Moodle)	2
Content module 3	20
Laboratory work «Computer technology at the register level» (report from work, protection)	2

<https://eprints.kname.edu.ua/56118/1/2020%2020%D0%9D%20%D0%BF%D0%B5%D1%87%20%D0%9F%D1%80%D0%B0%D0%BA%D1%82%D0%B8%D0%BA%D1%83%D0%BC%20%D0%9B%D0%A0%20%D0%90%D1%80%D1%85%D1%96%D1%82%D0%B5%D0%BA%D1%82%D1%83%D1%80%D0%B0%D0%9A%D0%BE%D0%BC%D0%BF%D0%A1%D0%B8%D1%81%D1%82%D0%B5%D0%BC%20%D0%9B%D0%B8%D1%82%D0%B2%D0%B8%D0%BD%D0%BE%D0%B2.pdf>

2. 2. Litvinov A.L. Praktikum z laboratornih robIt z arhItecturi komp'yuternih sistem: navch. posIbnik / A. L. Litvinov ; HarkIv. nats. un-t mIsk. gosp-va Im. O. M. Beketova. – HarkIv : HNUMG Im. O. M. Beketova, 2020. – 48 s. Dostup: <https://eprints.kname.edu.ua/56118/1/2020%2020%D0%9D%20%D0%BF%D0%B5%D1%87%20%D0%9F%D1%80%D0%B0%D0%BA%D1%82%D0%B8%D0%BA%D1%83%D0%BC%20%D0%9B%D0%A0%20%D0%90%D1%80%D1%85%D1%96%D1%82%D0%B5%D0%BA%D1%82%D1%83%D1%80%D0%B0%D0%9A%D0%BE%D0%BC%D0%BF%D0%A1%D0%B8%D1%81%D1%82%D0%B5%D0%BC%20%D0%9B%D0%B8%D1%82%D0%B2%D0%B8%D0%BD%D0%BE%D0%B2.pdf>

3. DIstantsIyniy kurs «ArhItectura komp'yuternih sistem» – <https://dl.kname.edu.ua/course/view.php?id=827>

Recommended literature and information resources

1. MatvIenko M. P., Rozen V. P., Zakladniy O. M. ArhItectura komp'yutera. Navchalniy posIbnik. – K.: Vidavnitstvo LIra-K. 2016. – 264 s.
2. Tararaka V.D. ArhItectura komp'yuternih sistem: navchalniy posIbnik. – Zhitomir : ZhDTU, 2018. – 383 s.
3. Tarnavskiy Yu. A., Kuzmenko I. M. OrganIzatsIya komp'yuternih merezh. – K.: KPI Im. Igorya SIKorskogo, 2018. – 259 s.
4. Tonkoshkur O.S., Gnilenko O.B. ArhItectura komp'yuterIv. MashinnI komandi ta programmuvannya na assemblerI. DnIpro: Vid-vo "Nova IdeologIya", 2018. – 179 s.
5. ArhItectura komp'yutera [Elektronniy resurs]. – Rezhim dostupu https://uk.wikipedia.org/wiki/ArhItectura_komp'yutera

Hardware, equipment, software products

Name of computer lab	Model and brand of personal computers, their number	Name of application packages (including licensed)	Internet access, availability of access channels (yes / no)
Laboratory of Informatics and Computer Engineering	Impression computer P + - 18 units multimedia projector	- ESET Antivirus Software - Office Pro 2013 Rus OLP NL Academy - Electronics Workbench electronic circuit modeling systems	yes