

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
ODESSA I.I. Mechnikov NATIONAL UNIVERSITY
Department of mathematical support of computer systems



Vice-rector for scientific and pedagogical work

20__

WORKING PROGRAM OF EDUCATIONAL COURSE

VB3 "Virtualization technologies in computer systems"

(course name)

Level of higher education Second (master's)

Field of knowledge 12 – Information technologies

Specialty 126 – Information systems and technologies

(code and name of specialty)

Educational and professional program Information systems and technologies

(EPP/ESP name)

Working program of the study course "Virtualization technologies in computer systems". – Odesa: ONU, 2022. – 10 p.

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The work program was approved at the meeting of the Department of Mathematical Support of Computer Systems

Protocol No. 1 from "25" 08 2022 year

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Agreed with the guarantor of the EPP "Information systems and technologies"

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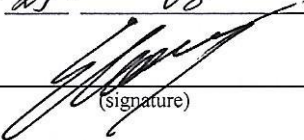
Approved by the educational and methodical commission (EMC) for IT specialties of the FMPhIT

Protocol No. 1 from "31" 08 2022 year

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Reviewed and approved at the meeting of the department _____

Protocol No. 1 from "29" 08 2023 year

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Reviewed and approved at the meeting of the department _____

Protocol No. ____ from " ____ " _____ 20__ year

Head of Department _____ (_____)
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1. Course description

Name of indicators	Field of knowledge, specialty, specialization, level of higher education	Characteristics of the academic discipline	
		<i>full-time education</i>	<i>external form of education</i>
Total number: credits – 4 hours - 120 content modules - 3	Branch of knowledge <u>12 - Information technologies</u> Specialty <u>126 – Information systems and technologies</u> Level of higher education: <u>Second (master's)</u>	<i>Optional</i>	
		<i>Year of preparation:</i>	
		1st	-and
		<i>Semester</i>	
		1st	-and
		<i>Lectures</i>	
		18 hours	8 hours
		<i>Practical, seminar</i>	
		<i>Laboratory</i>	
		18 hours	6 hours
		<i>Independent work</i>	
		84 hours	106 hours
		Final control form: credit	

2. The purpose and tasks of the educational course

The purpose is the study and acquisition of knowledge and skills about virtualization technologies, terminology, varieties and main advantages of virtualization.

Task:

- familiarization with the basics of virtualization technologies;
- familiarization with solutions of leading IT vendors and features of Microsoft and VMware virtualization platforms;
- study of means of virtualization of desktop platforms using the Oracle VM VirtualBox platform as an example;
- preparation for the completion of diploma projects and qualification works, the topics of which are related to the solution of analytical and predictive problems, and the development of distributed network information systems.

The process of studying the discipline is aimed at forming elements of the following competencies:

a) general (ZK): —

c) special professional (SC):

SK01. Ability to develop and apply IST necessary for solving strategic and current tasks.

SK03. The ability to design information systems taking into account the specifics of their purpose, incomplete / insufficient information and conflicting requirements.

Program learning outcomes:

PH03. Make effective decisions on the problems of information infrastructure development, creation and application of ICT.

PH06. Justify the choice of technical and software solutions, taking into account their interaction and potential impact on solving organizational problems, organize their implementation and use.

PH07. Make a reasonable choice of project solutions and design a service-oriented information architecture of the enterprise (institution, organization, etc.).

Expected learning outcomes. As a result of studying the academic discipline, the student should

know: basic terms and key concepts of virtualization, main varieties of virtualization, modern virtualization platforms and their components.

be able: design and administer a distributed network information system based on knowledge of basic architectures, protocols and principles of virtualization using modern Oracle, VMware and Microsoft platforms and environments.

3. Course content

Content module 1. Concepts and trends in the development of virtualization technology in computer systems and networks.

Тема 1. History, modern technologies and virtualization platforms, features and benefits

Literature: [1, 2, 4, 6].

Тема 2. Architecture and features of virtual machines.

Literature: [1, 4, 6, 8].

Content module 2. Architectures, system components and functioning of various types of virtualization.

Тема 3. Server virtualization (full virtualization and paravirtualization).

Literature: [1, 2, 5, 7, 8].

Тема 4. Virtualization at the level of operating systems.

Literature: [1, 2, 4, 5, 6].

Тема 5. Application virtualization and workplace virtualization.

Literature: [1, 5, 6, 8]

Content module 3. Virtualization platforms.

Тема 6. Microsoft virtualization technologies and platforms.

Literature: [1, 3, 4, 5, 10].

Тема 7. Virtualization technologies and platforms of the company VMware|.

Literature: [1, 4, 5, 6].

Тема 8. Virtualization technologies and platforms in the Linux OS (Xen, KVM, QEMU, LXC, Docker).

Literature: [1, 4, 5, 6, 7, 12, 13].

4. Course structure

Names of content modules and topics	Number of hours									
	Full-time					Correspondence form				
	That's all	including				That's all	including			
		1	p	lab	W ed		1	p	lab	Wed
1	2	3	4	5	6	7	8	9	10	11
Content module 1. Concepts and trends in the development of virtualization technology in computer systems and networks.										
Topic 1.	11	2		2	7		1		1	10
Topic 2.	14	2		2	10		1		1	10
Content module 2. Architectures, system components and functioning of various types of virtualization.										
Topic 3.	14	2		4	10		1		2	12
Topic 4.	11	2			8		1			14
Topic 5.	10	2			7		1			14
Content module 3. Virtualization platforms.										
Topic 6.	19	2		6	14		1		1	14
Topic 7.	19	2			14		1			16
Topic 8.	22	4			4	14		1		
Hours in general	120	18		18	84	120	8		6	106

5. Topics of seminar classes

There is none

6. Topics of practical classes

There is none

7. Topics of laboratory classes

No s/p	Topic name	Number hours
1	Getting to know the virtual machine Oracle VM VirtualBox / VMware Workstation.	2
2	Work with Oracle VM VirtualBox / VMware Workstation. Snapshots and cloning.	2
3	Work with virtual networks.	4
4	Working with clusters of virtual machines on the VMware VShpere platform.	6
5	Virtualization technologies in the Linux OS.	4
	Together	18

8. Independent work

No s/p	Title of the topic / types of tasks	Number hours
1	Modern technologies and virtualization platforms, features and advantages. [1], [2]	7
2	Architecture and features of virtual machines. [1], [2]	10
3	Server virtualization (full virtualization and paravirtualization). [1], [2]	10
4	Virtualization at the level of operating systems. [1], [2]	8
5	Application virtualization and workplace virtualization. [1], [2]	7
6	Microsoft virtualization technologies and platforms. [1], [2]	14
7	Virtualization technologies and platforms of the company VMware . [1], [2]	14
8	Virtualization technologies and platforms in the Linux OS (Xen, KVM, QEMU, LXC, Docker). [1], [2]	14
	Together	84

Independent work includes:

- [1] – preparation for lectures, practical, seminar, laboratory classes;
- [2] – writing essays on the topic, as well as delivering reports on the topic.

9. Teaching methods

Lectures using multimedia presentation material.

10. Control methods

During the defense of the laboratory work, the student must demonstrate the results of the laboratory work, a report on their implementation, and show an understanding of the main steps of the laboratory work and their meaning.

During the final control, the student must answer 14 test questions and 2 examiner questions from the list given in point 11.

10.1. Evaluation criteria for the final modular control:

1. The answer should be complete and short. It should not contain material that does not relate to the essence of the question.
2. Clearly formulate statements, skillfully apply the necessary formulas and knowledge of the main issues of the program.
3. Answers with false statements are evaluated based on the closeness of the answer to the correct one.
4. Omissions in the justification of statements are taken into account and this leads to a decrease in the number of points.
5. Small flaws, inaccuracies in the presentation of the material, reduce the number of points.
6. Ignorance and misunderstanding of the main idea of a theoretical question or problem leads to the withdrawal of up to 90% of points.
7. If there is no answer to the question, zero points are assigned.

11. Questions for final control

1. Define the concept:
 - Emulation
 - Virtual machine
 - Virtual hard disk
 - Host system
 - Guest OS
 - Sandbox (container)
 - Full virtualization
 - Hardware virtualization
 - Dynamic (binary) broadcast
 - Paravirtualization
 - Virtualization at the OS level
 - Hypervisor type 1 (standalone)
 - Hypervisor type 2 (based on base OS)
 - Probros devices
2. Describe the advantages of virtualization:
 - Effective use of computing resources
 - Reduction of infrastructure costs
 - Reducing software costs
 - Increasing flexibility and responsiveness of the system

- Incompatible applications can run on the same computer
 - Increasing the availability of applications and ensuring business continuity
 - Easy archiving capabilities
 - Increasing manageability of infrastructure
3. Types of virtualization.
 4. The main features of virtualization.
 5. Microsoft virtualization technologies. Comparison of monolithic and microkernel hypervisor.
 6. Network interaction of virtual machines.
 7. VMware technologies. The VSphere platform.
 8. Virtualization technologies in the Linux OS (Xen, KVM, QEMU, LXC, Docker).
 9. Application of clusters and data storage networks in virtualization technologies.
Define the concept:
 - Cluster
 - Fault-tolerant clusters
 - Clusters with load balancing
 - Storage Area Network (SAN)
 - Live migration

12. Distribution of points received by students

Current testing and independent work									Sum
Content module #1		Content module No. 2			Content module #3			Final test	
T1	T2	T3	T4	T5	T6	T7	T8		
12	12	12			12		12	40	100

T1, T2 ... - topics of content modules, KR - course work, INDZ - individual educational and research task

Rating scale: national and ECTS

The sum of points for all types of educational activities	ECTS assessment t	Evaluation on a national scale	
		for an exam, course project (work), practice	for credit
90 - 100	AND	perfectly	counted
85-89	IN	fine	
75-84	WITH		
70-74	D	satisfactorily	
60-69	IS		
35-59	FX	unsatisfactory with the possibility of reassembly	not counted with the possibility of retaking

0-34	F	unsatisfactory with mandatory repeated study of the discipline	not enrolled with mandatory repeated study of the discipline
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13. Methodical support

Methodological support for laboratory work - materials in a folder on Google Drive, provided to students in electronic form and containing tasks to be performed and the necessary theoretical material with examples. Also regulatory documents.

14. Recommended Books

14.1. Basic literature

1. Andrew S. Tanenbaum and Herbert Bos. Modern Operating Systems (4th. ed.). Prentice Hall Press, USA. 2014.
2. Yosifovich P, Russinovich M, Ionescu A, Solomon D. Windows Internals: System architecture, processes, threads, memory management, and more, Part 1. 7th ed. Hoboken: Pearson Education Limited; 2017.
3. Mitch Tulloch, Understanding Microsoft Virtualization Solutions: From Desktop to Datacenter. Microsoft Press, (2009)– URL: <https://download.microsoft.com/download/5/b/4/5b46a838-67bb-4f7c-92cb-eabca285dfdd/693821ebook.pdf>

14.2. Supporting literature

4. Kostyuchenko A.O., Goroshko Yu.V. Virtualization of operating systems: training manual. Ch.: FOP Balykina S.M., 2021. 56 p.
5. Holovnya O. S. Systematization of virtualization technologies. Information technologies in education. Issue 12. 2012. P. 127-133. URL: http://nbuv.gov.ua/UJRN/itvo_2012_12_20
6. Building virtualization systems using Hyper-V, VMWare, Proxmox - Access mode <https://techexpert.ua/it-services/building-of-virtualization-systems/>
7. Tormasov A. Virtualization of operating systems [Electronic resource] - Access mode: <http://www.osp.ru/os/2002/01/180946/>
8. Tormasov A. Sovremennaya virtualizatsiya [Electronic resource] - Access mode: <http://www.osp.ru/os/2007/02/4108084/>
9. Rechistov G. Hardware virtualization. Theory, reality and support in processor architectures [Electronic resource] - Access mode: <http://habrahabr.ru/company/intel/blog/196444/>
10. Naumuk O. V. Hyper-V capabilities for organizing practical classes on operating system administration. Pedagogical discussion. Issue 14. Khmelnytskyi Humanitarian and Pedagogical Academy, 2013. C. 327-330.
11. Catling, Robin. The VirtualBox Networking Primer: Connecting and Configuring Virtual Machines. Great Britain, Proactivity Press, 2020.

12. Berke. Linux, Virtualization and Virtual Machine // Medium [Electronic resource] - Access mode: <https://medium.com/@berkeucyildiiz/linux-virtualization-and-virtual-machine-18a09f1321a3>
13. Igor Ljubuncic Welcome to KVM virtualization - Thorough introduction. [Electronic resource] - Access mode: http://rus-linux.net/nlib.php?name=/MyLDP/vm/KVM/kvm_introduction.html
14. Linux, Apache, MySQL, PHP in an LXC Container [Electronic resource] - Access mode: <https://zerovector.space/linux-apache-mysql-php-in-an-lxc-container>
15. Kotelnikov E. V. Network administration based on Microsoft Windows Server 2003, Course of lectures. - 2007.
16. Yu.V. Blinkov Study of computer operating systems using virtual machine technology. – Penza, 2011.
17. Architecture of VMware ESXi [Electronic resource] - Access mode: <https://www.vmware.com/techpapers/2007/architecture-of-vmware-esxi-1009.html>
18. VMware Infrastructure Architecture Overview [Electronic resource] - Access mode: https://www.vmware.com/pdf/vi_architecture_wp.pdf
19. vSphere Virtual Machine Administration - VMware vSphere 6.0 [Electronic Resource] - Access Mode: <https://docs.vmware.com/en/VMware-vSphere/6.0/vsphere-esxi-vcenter-server-601-virtual-machine-admin-guide.pdf>

15. Electronic information resources

1. VMware Hands-On Labs [Electronic resource] - Access mode: <http://labs.hol.vmware.com/>
2. virtualization.info | News digest about virtualization technologies, products, market trends. Since 2003. [Electronic resource] - Access mode: <http://virtualization.info/>
3. Oracle VM VirtualBox User Manual - Oracle Corporation [Electronic resource] - Access mode: <https://www.virtualbox.org/manual/UserManual.html>