

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ ЕКОНОМІЧНИЙ УНІВЕРСИТЕТ
ІМЕНІ СЕМЕНА КУЗНЕЦЯ

ЗАТВЕРДЖЕНО

на засіданні кафедри
інформаційних систем.
Протокол № 1 від 22.08.2023 р.



ПОГОДЖЕНО

Проректор з навчально-методичної роботи

Каріна НЕМАШКАЛО

ОПЕРАЦІЙНІ СИСТЕМИ

робоча програма навчальної дисципліни (РПНД)

Галузь знань	12 "Інформаційні технології"
Спеціальність	121 "Інженерія програмного забезпечення"
Освітній рівень	перший (бакалаврський)
Освітня програма	"Інженерія програмного забезпечення"

Статус дисципліни

Мова викладання, навчання та оцінювання

обов'язкова

англійська

Розробник:

к.т.н., доцент

підписано КЕП

Дмитро ГОЛУБНИЧИЙ

Завідувач кафедри
інформаційних систем

Дмитро БОНДАРЕНКО

Гарант програми

Олег ФРОЛОВ

Харків
2024

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

APPROVED

at the meeting of the department
information systems
Protocol № 1 of 22.08.2023



AGREED

Vice-rector for educational and methodical work

Karina NEMASHKALO

OPERATING SYSTEMS

Program of the course

Field of knowledge **12 "Information Technology"**
Specialty **121 "Software engineering"**
Study cycle **first (bachelor)**
Study programme **"Software engineering"**

Course status

mandatory

Language

English

Developers:

PhD (Technical sciences),
Associate Professor

digital signature

Dmytro HOLUBNYCHYI

Head of Information systems
department:
Ph.D. (Technical sciences),
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Ph.D. (Technical sciences),
associate professor

Oleg FROLOV

**Kharkiv
2024**

INTRODUCTION

The broad capabilities of computerized means in matters of collecting, processing and issuing the necessary information can significantly improve the quality of economic calculations, make the process of justifying economic decisions more effective. But the successful use of a powerful computerized tool is impossible without a clear idea of the features of the functioning of all its constituent parts, and this, in turn, requires solid knowledge of the processes that take place in the operating system at the level of resource management during their work. Knowledge of the basics of building operating systems is becoming more and more relevant, since the trends in the development of computer technology indicate that, on the one hand, the complexity and functionality of computer technology are constantly and rapidly growing, and on the other hand, there is a constant trend towards the personification of this complex techniques That is, the task of maintaining a personal computer in working condition, adjusting the operation of its software and configuration, timely upgrade (patch), increasingly becomes a problem not of professionals-specialists, but of a specific user of this personal computer.

Studying the discipline "Operating systems" involves acquiring theoretical knowledge and mastering practical skills related to the functioning of various objects of the operating system. The discipline is aimed at forming in students the general basics of the interaction of system and user software, which are necessary for compiling programs from common programming languages.

The purpose of the course "Operating Systems" is the provision of higher education to students systems of special knowledge for mastering the theoretical foundations of construction, principles of design, configuration and application of various modern operating systems that ensure the organization of computing processes in corporate information systems for economic, managerial, industrial, scientific and other purposes, as well as providing practical skills for automating everyday administration tasks.

The tasks of the course are:

- mastering the principles of construction, purpose, structure, function and evolution of operating systems, their subsystems, resource management mechanisms;
- mastering the basic methods of diagnostics, recovery, monitoring and optimization of operating system components;
- mastering the skills of interaction with objects of the operating system by studying their characteristics and methods of operation.

The subject of the course is a variety of operating systems, their architecture and main components and objects, which are considered in the form of sets of characteristics.

The object of the course is modern theoretical concepts and methodologies, principles of functioning, selection and practical implementation of components of the operating system.

The learning outcomes and competence formed by the course are defined in the table. 1.

Table 1

Learning outcomes and competencies formed by the course

Learning outcomes	Competencies
LO 07	GK 05, SK 13
LO 17	GK 02, SK 12
LO 21	SK 08

where, LO 07. To know and apply in practice the fundamental concepts, paradigms and basic principles of the functioning of linguistic, instrumental and computing tools of software engineering.

LO 17. To be able to apply methods of component software development.

LO 21. To know, analyze, choose, competently apply the means of ensuring information security (including cyber security) and data integrity in accordance with the applied tasks being solved and the software systems being created.

GK 02. Ability to apply knowledge in practical situations.

GK 05. Ability to learn and master modern knowledge

SK 08. Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering tasks

SK 12. Ability to carry out the system integration process, apply change management standards and procedures to maintain the integrity, overall functionality and reliability of the software.

SK 13. The ability to reasonably choose and master software development and maintenance tools.

COURSE CONTENT

Content module 1. Architecture of operating systems

Topic 1. Principles of building an operating system

1.1. The concept of an operating system (OS), its purpose. The operating system as an extended machine. The operating system as a resource allocator. The history of the development of operating systems. Generation of operating systems.

1.2. Typical architectures of operating systems. Auxiliary modules of the operating system. Kernel in privileged mode and user mode. Exchange between applications when using the kernel in privileged mode. Application programming interface. Monolithic systems. Multilevel systems. Microkernel architecture. Basic kernel mechanisms. Resource managers. System call interface. Hardware dependency and portability of the operating system. Typical hardware support tools.

Topic 2. Architecture of various operating systems

2.1. Windows OS architecture. Families and clones Windows. Windows OS compatibility. Interconnection of system modules.

2.2. ReactOS OS architecture. Functionality of ReactOS. Characteristics of the ReactOS core. Comparison of ReactOS architecture with other OSes. Characteristics of the ReactOS executive system.

2.3. Kolibri OS architecture. Functionality of Kolibri OS. The monolithic architecture of Kolibri OS. Kolibri OS modules. Characteristics of the Kolibri OS kernel.

2.4. Linux architecture. Linux System distributions. Version numbering. Linux Ubuntu. Linux kernel architecture.

Content module 2. RAM, streams and processes

Topic 3. Processes and flows in operating systems

3.1.Processes. Process functions. Application IDs. Process command line. Changing environments. Process status. Error handling. Working process directories. Creating and ending processes. Protection of processes from unprofitable code. Error and exception handling.

3.2.Streams Conditions for creating streams. Stream stack. Flow state. Flow execution periods. Creation and termination of threads. Allocation of processor time between threads. Changing the priority class of a thread. Delaying and resuming thread execution.

3.3.Flow planning and dispatching. Types of planning. Planning strategies. Displaceable and non-displaceable multitasking. Flow scheduling algorithms. Quantization. Flow planning in real-time systems.

3.4.Basic principles of flow interaction. The main problems of interaction of streams. Basic mechanisms of thread synchronization: semaphores, mutexes, critical sections, blocking variables, events. Component synchronizing objects. Timers. Distribution of time with exception. Thread queues and message processing.

Topic 4. Architecture and memory management.

4.1.Memory allocation methods. Memory segmentation. Page organization of memory. Page-segmental organization of memory. Virtual memory technology. Stopping. Logical and physical memory addressing. Virtual memory.

4.2.Virtual memory. Page organization on demand. Stages of processing the situation of the absence of a page in memory.

4.3.Dynamic memory allocation. Memory pools. Default heap. Creating an additional memory pool. Allocating and freeing memory in the heap. Checking the correctness of the data placed in the heap. Obtaining information about the protection of memory pages.

4.4.The concept of pumping. Loading pages on demand. Page replacement algorithms. Saving pages to disk. Slippage and management of the resident set. Implementation of virtual memory management in operating systems.

Content module 3. File system

Topic 5. Executable files of the operating system

5.1.General principles of composition. Static and dynamic layout. Structure of executable files. Sections of executable files. PE formats.

5.2.Concept of file and file system. Organization of information in the file system. Connections. file name and attributes. Operations on files and directories.

5.3.Physical organization of the file system. Basic information about disk devices. Placing information in file systems. Reliability and performance of file systems.

Topic 6. System registry

6.1.Using the registry editor. Windows system registry. The logical structure of the register. Physical organization of the register. Registry software interface. Compilation of reg-files.

6.2.Initialization files. Restore the registry. Export registry. Import the registry. Documentation of information in journals. Work with the magazine. Sources of messages. Compilation of message files.

6.3.Administration of system registry keys. Initialization file structure. Access to initialization files. Display private .ini files.

Content module 4. Network, multiprocessor operating systems and information protection

Topic 7. System services of the operating system

7.1.Management of services by the user. Windows service components. Names of services. Ways to view Windows services. Windows Services Options. Ways to disable services.

7.2.Management of services from the operating system. Schematic diagram of information exchange with Windows services. Service management manager. Service database structure. Registry settings for services and drivers. Service accounts.

Topic 8. Data protection in the operating system

8.1.The main tasks of ensuring the security of the operating system. Concept of cryptographic algorithm and protocol. Cryptosystems with a secret key. Public key cryptosystems. Hybrid cryptosystems. Digital signatures. Certificates.

8.2.Principles of authentication and management of access to operating system resources. Types of objects that are protected. Formation of access control lists. Implementation of protection of personal objects. User accounts. Audit General principles of audit organization. Working with the Linux syslog. Windows Event Log.

8.3.Principles of data encryption on file systems. Creating a crypto provider. Windows Encrypting File System. Network data security. Information protection at the network level. Information protection at the transport level.

8.4.General principles of loading operating systems. Hardware initialization of the computer. Loader operating system. Two-stage download. Loading and initializing the kernel. Loading system components.

The list of laboratory studies in the course is given in table 2.

Table 2

The list of laboratory studies

Name of the topic and/or task	Content
Topic 1. Laboratory work 1	Study of operating systems on virtual machines
Topic 2. Laboratory work 2	Study of the Linux Ubuntu operating system

Name of the topic and/or task	Content
Topic 3. Laboratory work 3	Study of the properties of processes and flows
Topic 4. Laboratory work 4	Study of Windows virtual memory
Topic 5. Laboratory work 5	Exploring Windows Executable Files
Topic 6. Laboratory work 6	Study of system services and registry of Windows OS
Topic 7. Laboratory work 7	Study of data protection methods
Topic 8. Laboratory work 8	Windows OS download research and optimization

The list of self-studies in the course is given in table 3.

Table 3

List of self-studies

Name of the topic and/or task	Content
Topic 1 - 8	Studying lecture material
Topic 1 - 8	Preparation for laboratory classes

The number of hours of lectures, laboratory classes and hours of self-study are given in the technological card for the course.

TEACHING METHODS

In the process of teaching the course, in order to acquire certain learning outcomes, to activate the educational process, it is envisaged to use such teaching methods as:

Verbal (lecture (Topic 1, 3, 4, 5, 6, 7), problematic lecture (Topic 8), lecture-visualization (Topic 2)).

Visual (demonstration (Topic 1 – 8)).

Laboratory work (Topic 1 – 8), case studies (Topic 1 – 2).

FORMS AND METHODS OF ASSESSMENT

The University uses a 100-point cumulative system for assessing the learning outcomes of students.

Current control is carried out during lectures, practical, laboratory and seminar classes and is aimed at checking the level of readiness of the student to perform a specific job and is evaluated by the amount of points scored:

– for courses with a form of semester control as grading: maximum amount is 100 points; minimum amount required is 60 points.

Final control includes current control and assessment of the student.

Semester control is carried out in the form of a grading.

The final grade in the course is determined:

– for disciplines with a form of grading, the final grade is the amount of all points received during the current control.

During the teaching of the course, the following control measures are used:

Current control: defense of laboratory works (64 points), written control work

(testing) (36 points).

Semester control: Grading.

More detailed information on the assessment system is provided in technological card of the course.

RECOMMENDED LITERATURE

Main

1. Голубничий Д.Ю. Операційні системи [Електронний ресурс] / Д.Ю. Голубничий, А.В. Холодкова. – Харків : ХНЕУ ім. С. Кузнеця, 2018. – 317 с. URL: <http://repository.hneu.edu.ua/handle/123456789/23844>.

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3. Tanenbaum E. Modern operating systems / E. Tanenbaum, H. Boss. - New Jersey: Pearson Prentice-Hall, 2020. - 1120 p.

4. Silberschatz A. Operating System Concepts / A. Silberschatz, G. Gagne, PB Galvin. - New Jersey: Wiley, 2021. - 1040 p.

Additional

5. Гаркуша І.М. Конспект лекцій з дисципліни “Операційні системи” для студентів галузі знань 12 “Інформаційні технології”. – Дніпро: НТУ «ДП», 2020. – 73 с.

6. Граннеман С. Linux. Кишеньковий довідник / С. Граннеман. – Київ: Діалектика, 2019. – 464 с.

7. Погребняк Б.І. Операційні системи : навч. посібник / Б.І. Погребняк, М.В. Булаєнко. – Харків: ХНУМГ ім. О. М. Бекетова, 2018. – 104 с.

8. Федотова-Півень І.М. Операційні системи : навчальний посібник. [за ред. В.М. Рудницького] / І. М. Федотова-Півень, І. В. Миронець, О. Б. Півень, С. В. Сисоєнко, Т. В. Миронюк. - Черкаський державний технологічний університет. – Харків : ТОВ «ДІСА ПЛЮС», 2019. – 216 с.

9. Зайцев В.Г. Операційні системи: навч. посіб. для студ. / В. Г. Зайцев, І. П. Дробязко; КПІ ім. І. Сікорського. – Київ: КПІ ім. І. Сікорського, 2019. – 240 с.

10. Uzayr Sb. Linux: The Ultimate Guide / Sufyan bin Uzayr. - Boca Raton: CRC Press, 2022. - 305 p.

11. Stollings V. Operation system / V. Stollings. - Washington: Pearson, 2020. - 1264

Information resources

12. Operating system ReactOS [Electronic resource]. – Access mode: <https://reactos.org>.

13. KolibriOS operating system [Electronic resource]. – Access mode: <http://kolibriOS.org>.

14. Linux Ubuntu operating system [Electronic resource]. – Access mode: <https://ubuntu.com/>

15. Sysinternals [Electronic resource]. – Access mode: <https://learn.microsoft.com/en-us/sysinternals/>.

16. Windows [Electronic resource]. – Access mode: <https://support.microsoft.com/en-us/windows>.

17. Holubnychyi D. "Operating systems" [Electronic resource]. – Access mode: <https://pns.hneu.edu.ua/course/view.php?id=1950>.