

### 3. Educational program

Director of the Master's degree programme - N.Kotenko, PhD in Education,  
Associate Professor of the Department of Software Engineering and Cyber Security

#### 1. Profile of the educational program "Software Engineering" from the specialty 121 "Software Engineering", subject area "Software Engineering"

1 – - General information	
Full name of the higher educational establishment and structural unit	State University of Trade and Economics Faculty of Information Technologies Department of Software Engineering and Cyber Security
Degree of higher education / vocational pre-higher education and title of qualification in original language	degree of higher education “master”  specialty “Software Engineering”
The official name of the educational program	“Software Engineering”
Compliance with the standard of higher education of the Ministry of Education and Science of Ukraine	Corresponds to the Higher Education Standards of the Ministry of Education and Science of Ukraine
Type of diploma and volume of educational program	Master's degree, unitary, 90 ECTS credits, term of training – 1 year 4 months
Presence of accreditation	National Agency for Quality Assurance in Higher Education of Ukraine; Decision № 17 (3.97) dated 23.12.2019; The certificate is valid until 23.12.2024.
Cycle / Level	NRC Ukraine - 8 level, FQ-EHEA - second cycle, EQF-LLL - 7 level
Prerequisites	Scientific degree - Bachelor
Language (s) Teaching	Ukrainian
Validity of the	1 year 4 months

educational program	
Internet address of the permanent placement of the description of the educational program	<a href="https://knute.edu.ua">https://knute.edu.ua</a>
<b>2 – The purpose of the educational program</b>	
Formation of the personality of a specialist, capable to solve complex non-standard tasks and problems of research and innovative character in the field of software engineering	
<b>3 – Characteristics of the educational program</b>	
Subject area	<p>Object of study and activity: processes of software development, modification, analysis, quality assurance, implementation and maintenance.</p> <p>Training goals: training of specialists who are able to solve complex tasks and problems in the development, quality assurance, implementation and support of software tools, which involves conducting research and/or implementing innovations and is characterized by the uncertainty of conditions and requirements.</p> <p>Theoretical content of the subject area: basic mathematical, infological, linguistic, economic conceptual provisions regarding the development and maintenance of software and ensuring its quality.</p> <p>Methods, techniques and technologies: methods of analysis and modeling of the application area, identification of information needs, classification and analysis of data for software design; methods of developing software requirements; methods of analysis and construction of software models; methods of software design, construction, integration, testing and verification; methods of modifying software components and data; reliability and quality models and methods in software engineering; software project management methods.</p> <p>Tools and equipment: software, hardware and cloud tools to support software engineering processes.</p>
Orientation of educational program	The program is focused on educational, professional and applied training
The main focus of the educational program and specialization	<p>Educational and professional. Emphasis on the ability of the specialist to carry out research and innovation activities in the real conditions of industrial software production.</p> <p>Keywords: functional programming, logical programming, biometric authentication technologies;</p>

	GRID technologies; design of multimedia systems; security of telecommunication networks
Features of the program	Integration of professional training in the field of software engineering with innovative activities, focus on the implementation of real software projects.
<b>4 - Eligibility of graduates for employment and further training</b>	
Eligibility for employment	Graduates of EP can work as specialists in the design, development and testing of software in the field of information technologies and occupy the following primary positions (according to the National Classifier of Professions of Ukraine DK 003:2010: 2132.1 and 2132.2.
Further education	Studying for the programs: the third educational (educational-scientific) level, the first scientific degree
<b>5 – Teaching and evaluation</b>	
Teaching and learning	Student-centered learning, self-learning, learning through laboratory practice, problem-based, interactive, project-based, information-computer, self-developing, collective and integrative, contextual learning technologies.
Assessment	Evaluation of students' educational achievements is carried out on the basis of: "Regulations on the organization of the educational process of students"; "Regulations on evaluation of the results of studies of students and postgraduates at SUTE"; Assessment is carried out through: written exams, defense of practice, defense of laboratory and/or practical works, current testing, defense of individual works, defense of qualification work.
<b>6 – Program competencies</b>	
Integral competence	A person's ability to solve complex problems and problems in a particular field of professional activity or in the learning process, which involves research and / or innovation and is characterized by uncertainty of conditions and requirements.
General competences (GC)	GC01. Ability to abstract thinking, analysis and synthesis. GC02. Ability to communicate in a foreign language both orally and in writing. GC03. Ability to conduct theoretical and applied research at the appropriate level. GC04. Ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge / types of economic activity). GC05. Ability to generate new ideas (creativity).

<p>Special competencies (SC )</p>	<p>SC01. Ability to analyze subject areas, form, analyze and model software requirements.</p> <p>SC02. Ability to develop and implement scientific and / or applied projects in the field of software engineering.</p> <p>SC03. Ability to design software architecture, model the operation of individual subsystems and modules.</p> <p>SC04. Ability to develop and implement new competitive ideas in software engineering.</p> <p>SC05. Ability to develop, analyze and apply specifications, standards, rules and guidelines in the field of software engineering.</p> <p>SC06. Ability to effectively manage financial, human, technical and other project resources in the field of software engineering.</p> <p>SC07. Ability to critically comprehend problems in the field of information technology and on the border of fields of knowledge, to integrate relevant knowledge and solve complex problems in broad or multidisciplinary contexts.</p> <p>SC08. Ability to develop and coordinate processes, stages and iterations of the software life cycle based on the application of modern models, methods and technologies of software development.</p> <p>SC09. Ability to ensure software quality.</p>
<p>7 – Program learning outcomes</p>	
	<p>PLO 01. To know and apply modern professional standards and other legal documents on software engineering</p> <p>PLO 02. To evaluate and select effective methods and models for the development, implementation, maintenance of software and management of relevant processes at all stages of the life cycle.</p> <p>PLO 03. To build and research models of information processes in the application field.</p> <p>PLO 04. To identify information needs and classify data for software design.</p> <p>PLO 05. To develop, analyze, justify and systematize software requirements.</p> <p>PLO 06. To develop and evaluate software design strategies; substantiate, analyze and evaluate design solutions in terms of quality of the final software product, resource constraints and other factors.</p> <p>PLO 07. To analyze, evaluate and apply at the system level modern software and hardware platforms to solve complex problems of software engineering.</p>

	<p>PLO 08. To develop and modify software architecture to meet customer requirements.</p> <p>PLO 09. Reasonably to choose paradigms and programming languages for software development; to apply in practice modern software development tools.</p> <p>PLO 10. To modify existing and develop new algorithmic solutions for detailed software design.</p> <p>PLO 11. To ensure quality at all stages of the software life cycle, including using relevant models and assessment methods, as well as automated software testing and verification tools.</p> <p>PLO 12. To make effective organizational and managerial decisions in conditions of uncertainty and changing requirements, compare alternatives, assess risks.</p> <p>PLO 13. To configure software, manage its changes and develop software documentation at all stages of the life cycle.</p> <p>PLO 14. To predict the development of software systems and information technology .</p> <p>PLO 15. To carry out software reengineering in accordance with customer requirements.</p> <p>PLO 16. To plan, organize and perform software testing, verification and validation.</p> <p>PLO 17. To collect, analyze, evaluate the information needed to solve scientific and applied problems, using scientific and technical literature, databases and other sources.</p>
<b>8 – Resource support for the implementation of the program</b>	
Personnel provision	<p>Project team: 2 Phd and 1 Doctor</p> <p>All developers are full-time employees of the Kyiv National University of Trade and Economics.</p> <p>Scientific and pedagogical workers with scientific degrees and / or academic titles, as well as highly qualified specialists are involved in the implementation of the program.</p> <p>In order to improve their professional level, all scientific and pedagogical workers undergo internships at least once every five years.</p>
Material and technical support	Use of SUTE laboratories, computer and specialized classrooms
Informational and educational support	The single digital space of the University combines all departments that are aimed at shaping the individual trajectory of a higher education seeker. The MOODLE distance learning system, the educational platform of the

	university "MIA: Education" and the MS Office 365 environment ensure classroom, independent and individual work of students.
<b>9 – Academic mobility</b>	
National credit mobility	National credit mobility is carried out in accordance with concluded agreements on academic mobility
International credit mobility	International credit mobility is implemented through the conclusion of agreements on international academic mobility (Erasmus+), on double graduation, on long-term international projects that involve student training, the issuance of a double diploma, etc.
Education for foreign students	Provided.

## 2. List of components of the educational program and their logical consistency

### 2.1. List of components of EP

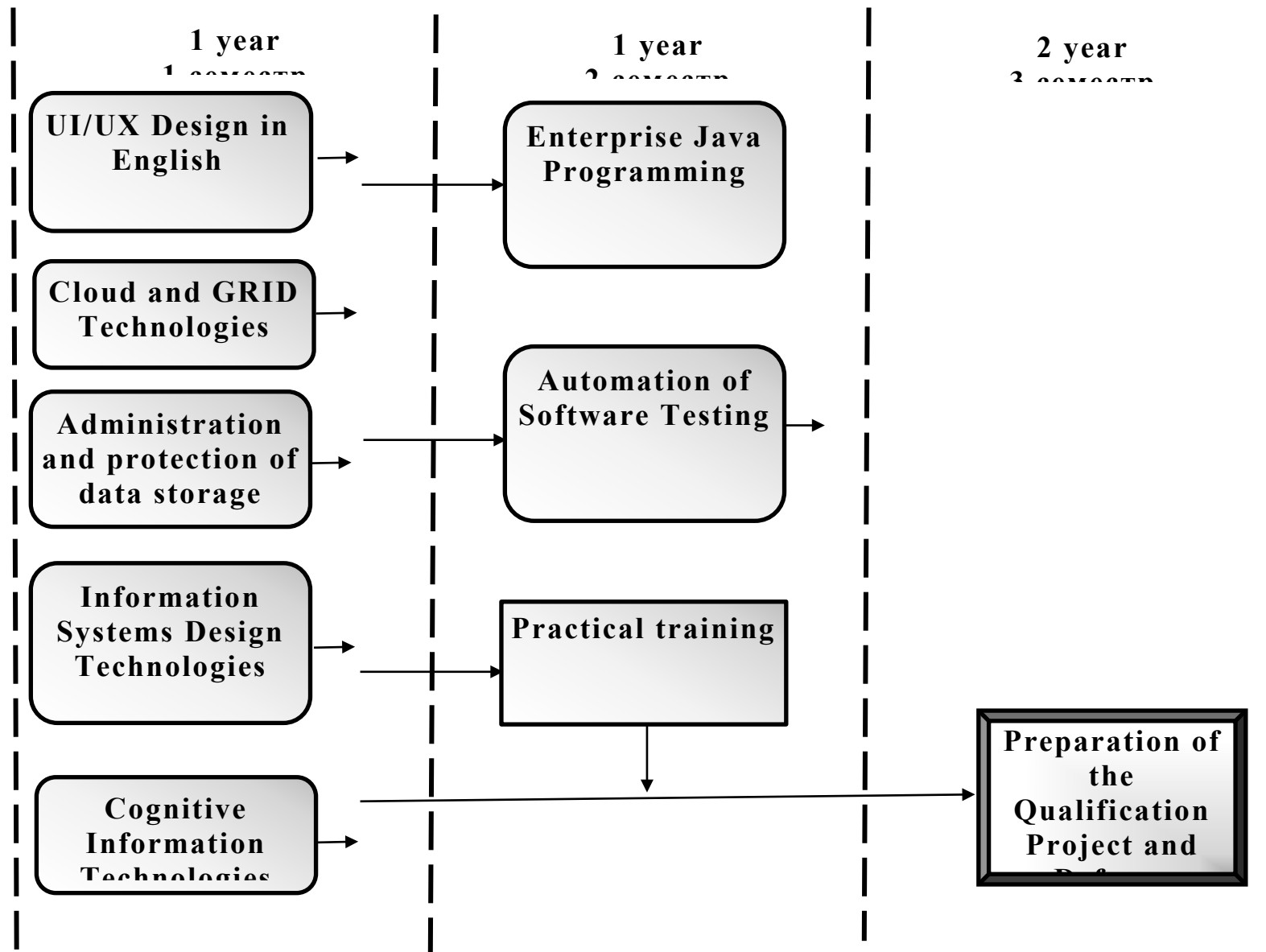
Code e/d	Components of the educational program ( academic disciplines, course projects (works), practices, qualification exam, final qualifying work)	Number of credits
1	2	3
<b>Compulsory Components of EP</b>		
CC 1.	UI/UX Design in English	6
CC 2.	Cloud and GRID Technologies	6
CC 3.	Administration and protection of data storage	6
CC 4.	Information Systems Design Technologies	6
CC 5.	Cognitive Information Technologies	6
CC 6.	Enterprise Java Programming	7,5
CC 7.	Automation of Software Testing	6
CC 8.	Practical training	10,5
CC 9.	Preparation of the Qualification Project and Defence	12
Total of Compulsory Components:		66
<b>Optional Components of EP</b>		
OC 1	VR Technologies and 3D Modeling	6
OK 2.	Architecture and Technologies of Mobile Application Programming	6
OC 3.	Biometric Authentication Technologies in Information Systems	6
OC 4.	Protection of Electronic Communication Systems	6
OC 5.	Intellectual Property	6
OC 6.	Information technologies in the system of economic security of the state	6
OC 7.	IT Law	6
OC 8.	Methods and Means of Information Protection in Computer Systems	6
OC 9.	Enterprise Information System Programming and Administration	6
OC 10.	Basics of cyberdiplomacy in English	6
OC 11.	Multimedia Systems Design	6
OC 12.	Psychology of Adaptation	6
OC 13.	Business Psychology	6
OC 14.	WPF-application Technologies	6
OC 15.	Web resource security technologies	6
OC 16.	Data Analysis Technologies	6

OC 17.	Management of software products	6
OC 18.	Philosophy of Personality	6
OC 19.	Functional and Logical Programming	6
Total of Optional Components		24
Total of Educational Program		90

For all components of the educational program the form of final control is an exam.



## 2.1. Structural Logic Scheme of Educational Program



### 3. Form of attestation of applicants for higher education

Attestation is carried out in the form of public defense of qualification work.

The qualifying work must solve a complex problem or problem in software engineering and involve conducting research and/or implementing innovations.

The qualifying work should not contain academic plagiarism, fabrication, or falsification. The qualification work must be published on the official website of the higher education institution or its subdivision, or in the repository of the higher education institution.

The publication of qualifying works with limited access is carried out in accordance with the requirements of the law.

#### 3.1. Matrix of correspondence of program competencies with the compulsory components of the educational program

Components Competencies	CC 1	CC 2	CC 3	CC 4	CC 5	CC 6	CC 7	CC 8	CC 9
GC01	+	+	+	+	+	+	+	+	+
GC02	+	+			+	+	+	+	+
GC03	+	+		+			+	+	+
GC04	+	+	+	+				+	+
GC05	+	+		+	+		+	+	+
SC01				+	+	+	+	+	+
SC02		+		+		+		+	+
SC03				+		+		+	+
SC04		+		+				+	+
SC05				+	+	+		+	+
SC06	+			+			+	+	+
SC07	+	+		+	+		+	+	+
SC08	+		+	+			+	+	+
SC09	+		+			+	+	+	+

### 3.2. Matrix of correspondence of program competences with optional components of the educational program

Components Competencies	OC1	OC2	OC3	OC4	OC5	OC6	OC7	OC8	OC9	OC10	OC11	OC12	OC13	OC14	OC15	OC16	OC17	OC18	OC19
GC01	+	+	+	+	+	+	+	+	+	+	+			+	+	+			+
GC02	+	+				+			+		+			+	+				
GC03	+		+		+	+										+			+
GC04							+				+	+	+	+			+	+	
GC05	+	+	+				+			+	+	+	+					+	+
SC01	+	+	+						+		+			+		+			+
SC02	+	+	+	+				+								+			
SC03	+	+		+					+								+		
SC04	+	+					+		+		+			+					
SC05		+							+						+				
SC06			+				+							+			+		
SC07	+					+					+					+			+
SC08	+									+						+	+		+
SC09	+	+	+											+	+				+

3.3. Matrix of correspondence of program learning outcomes (PLO) with relevant compulsory components of the educational program

Components Program learning outcomes	CC 1	CC 2	CC 3	CC 4	CC 5	CC 6	CC 7	CC 8	CC 9
PLO 01	+	+	+	+	+	+	+	+	+
PLO 02	+			+		+	+	+	+
PLO 03	+			+				+	+
PLO 04	+		+	+		+	+	+	+
PLO 05	+	+		+				+	+
PLO 06	+			+			+	+	+
PLO 07		+		+				+	+
PLO 08	+			+	+	+		+	+
PLO 09						+		+	+
PLO 10						+		+	+
PLO 11		+		+	+	+	+	+	+
PLO 12	+	+		+				+	+
PLO 13			+	+		+		+	+
PLO 14		+	+	+	+			+	+
PLO 15	+		+	+				+	+
PLO 16				+			+	+	+
PLO 17	+			+	+	+		+	+



4. Matrix of correspondence of program learning outcomes (PLO) with relevant optional components of the educational program

optional components program learning outcomes	OC 1	OC 2	OC 3	OC 4	OC 5	OC 6	OC 7	OC 8	OC 9	OC 10	OC 11	OC 12	OC 13	OC 14	OC 15	OC 16	OC 17	OC 18	OC 19
PLO 01	+	+	+	+	+		+	+	+		+			+	+	+			+
PLO 02	+	+	+					+	+		+			+		+	+		+
PLO 03						+		+	+		+					+	+		
PLO 04	+	+	+						+		+			+	+	+			+
PLO 05								+	+						+				
PLO 06											+						+		
PLO 07									+		+								
PLO 08									+		+				+				
PLO 09	+	+												+					+
PLO 10	+	+												+					+
PLO 11	+	+							+		+			+					+
PLO 12				+					+							+			

PLO 13		+					+									+		+
PLO 14			+					+								+		
PLO 15	+	+												+				+
PLO 16							+							+				
PLO 17			+	+	+		+	+	+		+	+	+			+		+

#### 4.1. Name. UI/UX DESIGN IN ENGLISH

Type. Compulsory

Year of study. 2024/2025

Semester. 1.

Lecturer, academic title, scientific degree, position. N.Kotenko, Associate Professor, PhD in Education, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. A clear understanding of how the design process works. Basic knowledge in the field of UI/UX design. Practical skills in using Figma tools to build wireframes, mockups and prototypes of software products according to the given task or formulated problem. Ability to perform interface testing.

Compulsory previous educational disciplines: "English for specific purposes", "Information technologies in professional activity".

Content. What is design and how does it work? How the design process is arranged. Methods and processes. What approaches exist. What approaches and when is better to use. Business needs research. Designer tools. How the software changed. Principles of working with Figma. Basics of the interface. Layout organization. Site elements. Styles, grids, and autolayouts. Visual design: fonts and typography. Collection of data from the customer. Analysis of competitors. Poll. Information architecture. Design system and UI kit. iOS, Android. Features and guidelines. Web analytics. Testing interfaces.

Recommended sources and other learning resources/tools.

1. Hill A. Complete figma tutorial for ui/ux: the comprehensive beginners to expert guide for learning and mastering FIGMA for UI/UX with pictures and illustrations. Independently Published, 2022.

2. Nielsen norman group: UX training, consulting, & research. Nielsen Norman Group. URL: <https://www.nngroup.com/>

3. Staiano F. Designing and Prototyping Interfaces with Figma: Learn essential UX/UI design principles by creating interactive prototypes for mobile, tablet, and desktop. Packt Publishing, 2022. 382 p.

Planned educational activities and teaching methods. The study of the discipline is conducted through lectures (auditory) and laboratory classes (in a computer classroom on a PC), which ensure the consolidation of theoretical knowledge and contribute to the assimilation of practical skills.

Evaluation methods.

– current control (computer testing, survey);

- final control (exam).

Language of learning and teaching. English

#### 4.2. Name. CLOUD AND GRID TECHNOLOGIES



Type. Compulsory

Year of study. 2024/2025

Semester. 1.

Lecturer, academic title, scientific degree, position. A.Desiatko, Associate Professor, PhD, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Analyze and choose optimal solutions for the involvement of Grid systems and cloud computing technologies in the direction of their application for conducting scientific research, as well as for the creation of a unified computing environment at the level of an organization, enterprise or individual entrepreneur; deploy a park of virtual private servers and configure server software of cloud systems; solve problems of scalability, design and operation of distributed information systems, products, services of information technologies; apply basic knowledge of standards in the field of information technologies during the development and implementation of distributed computing systems based on cloud technologies and services; design software components to work as services as part of distributed computing systems and complexes and cloud computing.

Compulsory previous educational disciplines. "Basics of software engineering", "Object-oriented programming". "Databases"

Content. Basic concepts and classification of cloud computing systems. Basic concepts and classification of grid systems. Classification of cloud computing systems. Basic components of cloud computing. Fundamentals of data processing centers (DTCs). The main scenarios of application of cloud computing technologies. Cloud technologies. The main scenarios of application of cloud computing technologies. Application of cloud computing to solve business problems. Microsoft Azure cloud platform, Amazon Web Services. General overview of modern cloud computing platforms. Software development for cloud computing. The use of databases in the development of software for cloud computing. Basic technologies of cross-platform software development. Fog technologies as a component of cloud computing. Data security in cloud environments.

Recommended sources and other learning resources/tools.

1. Зінченко О.В., Іщеряков С.М., Прокопов С.В., Серих С.О., Василенко В.В. Хмарні технології. – Навчальний посібник. – К: ФОП Гуляєва В.М., 2020.

2. Юрчишин, В. Я. Хмарні та Грід-технології: навчальний посібник для студентів спеціальності 121 «Інженерія програмного забезпечення» (освітня програма «Програмне забезпечення комп'ютерних та інформаційно-пошукових систем») – Київ : КПІ ім. Ігоря Сікорського, 2019. – 263 с.

3. Портал хмарного сервісу Azure Microsoft – Режим доступу: <https://azure.microsoft.com/en-us/training/>

Planned educational activities and teaching methods.

A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic, problem-based); practical classes (traditional); independent work (using programming elements).

Evaluation methods.

– current control (computer testing, survey);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.3. Name. ADMINISTRATION AND PROTECTION OF DATA STORAGEES

Type. Compulsory

Year of study. 2024/2025

Semester. I

Lecturer, academic title, scientific degree, position. S.Rzaeva, Associate Professor, PhD in Technical Sciences, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Formation of theoretical knowledge and practical skills necessary for the analysis of the effectiveness of the selected data storage protection system, justification of the choice of technical and software tools for effective administration and protection of data storage; ensuring the reliability of the operation of data warehouses, taking into account the factors of user error.

Compulsory previous educational disciplines: "Cloud and GRID technologies", "Technologies of designing information systems".

Content. Concept of database, data storage, database system. Characteristics and classification of OLTP systems, OLAP systems. General characteristics of data warehouses (Data Warehouse). Types of data storage systems: MOLAP (Multidimensional), ROLAP (Relational), HOLAP (Hybrid). Characteristics of the multidimensional data model. Software data storage tools: tools for integrating heterogeneous databases, data storage management tools, data analysis tools (Data Mining), tools for visualization of processing results. Creation of data windows (Data Mart). Data warehouse protection tools (DataWarehouse). General characteristics of NoSQLTP systems, OLAP systems. data management systems. Means of protection of NoSQLTP systems, OLAP systems. data management systems. General characteristics of NewSQLTP systems, OLAP systems. data management systems. Means of protection NewSQLTP - systems, OLAP - systems. data management systems. General characteristics of cloud data management systems. Means of protection of cloud data management systems. Protection of data lakes (DataLTP - systems, OLAP - systems. akes).

Recommended sources and other learning resources/tools.

1. Демиденко М.А. Введення в сучасні бази даних : навч. посіб. / М.А. Демиденко. – Д. : НТУ «Дніпровська політехніка, 2020. – 38 с.
2. Пасічник В.В. Сховища даних: підручник. / В.В. Пасічник, Н.Б. Шаховська – Л. : **Магнолія**, 2021. – 496 с.
3. Matt How The Modern Data Warehouse in Azure: Building with Speed and Agility on Microsoft's Cloud Platform. – Apress; 1st ed. edition (June 16, 2020), 304 p.

Planned educational activities and teaching methods. The study of the discipline is conducted through lectures (auditory) and laboratory classes (in a computer classroom on a PC), which ensure the consolidation of theoretical knowledge and contribute to the assimilation of practical skills.

Evaluation methods.

– current control (computer testing, survey);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.4. Name. INFORMATION SYSTEM DESIGN TECHNOLOGIES

Type. Compulsory

Year of study. 2024/2025

Semester. I

Lecturer, academic title, scientific degree, position M.Tsiutsiura,

Professor, Doctor of Technical Sciences, Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Be able to conduct in-depth analysis and justification of system design methods; design a user interface; master the design of databases, programs and transactions; build and use domain models using CASE tools. Have the skills to design and develop simple frameworks of systems based on hierarchies of abstract classes (based on interfaces, based on strategies and using graph-oriented approaches); use of modeling and high-level programming languages to solve design problems; development of main system components using RAD methodology and CASE technologies.

Compulsory previous educational disciplines: "Object-oriented programming", "Software architecture and design", "Information security of information systems and networks", "Operating systems".

Content. Features of the development of software complexes and computer software systems of engineering analysis. Detailed design of the software complex. Classic software design methods. Structural approach. Requirements analysis. Disadvantages Basics of object-oriented design of software complexes. Design of class hierarchies (applicable programs, libraries, frameworks). Features of CAE engineering analysis systems. Development of computing subsystems within the client-server architecture. Creation of infrastructure for calculations on high-performance computer systems. Development of the architecture of a complex computational method (logical level). Development of data structures (at the data level) Integration of the created data structures into the framework of the CAE system (user level). Software implementation of COM (logic level). Debugging and testing of the created software implementation of COM.

Recommended sources and other learning resources/tools.

1. Пономаренко В. С. Проектування інформаційних систем: посібник [Текст] / В. С. Пономаренко – К. : Видавничий центр «Академія», 2020. – 234с.

2. Катренко А. В. Системний аналіз: посібник [Текст]/ А. В. Катренко – Львів: Новий світ : 2019 – 2000 с.

3. Недашківський О. М. Планування та проектування інформаційних систем: посібник [Текст] / О. М. Недашківський. – Київ, 2018. – 215 с.

Planned educational activities and teaching methods. A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic, problem-based); practical classes (traditional); independent work (using programming elements).

Evaluation methods.

– current control (computer testing, survey);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.5. Name. COGNITIVE INFORMATION TECHNOLOGIES

Type. Compulsory

Year of study. 2024/2025

Semester. I

Lecturer, academic title, scientific degree, position O.Kryvoruchko, Professor, Doctor of Sciences (Engineering), Head of the Department of Software Engineering and Cyber Security, A.Yerukaiev, PhD in Technical Sciences, Associate Professor, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Formation of future specialists' knowledge about Bayesian models of perceptual decision-making and actions. This discipline allows students to learn the principles of modeling observations based on which conclusions are drawn about the state of the world based on sensory observations.

Compulsory previous educational disciplines: "Fundamentals of software engineering", "Object-oriented programming", "Java technology", "Algorithms and data structures", "Databases" and "Internet programming".

Content. Uncertainty and derivation. Application of Bayes rule. Bayesian inference under conditions of noisy measurements. Distribution of feedback. Combination of signs and accumulation of certificates. Learning as output. Distinction and finding. Binary classification. Interfering with top-level variables and ambiguity. Same and different incentives. Localization and target finding. Derivation in a changing world. Combining output with utility. The neural likelihood function.

Recommended sources and other learning resources/tools.

1. Rob High. Cognitive Computing with IBM Watson: Build smart applications using artificial intelligence as a service / R.High, T.Bakshi – Packt Publishing – 2019. – 258 p.

2. András Kornai. Vector Semantics (Cognitive Technologies) / A.Kornai – Springer – 2023. –289 p.

Planned educational activities and teaching methods.

A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic, problem-based) with the use of multimedia tools and video demonstrations; practical works (traditional, training tasks, computer testing).

Evaluation methods.

– current control (computer testing, survey);

- final control ( writing exam).

#### 4.6. Name. ENTERPRISE JAVA PROGRAMMING

Type. Compulsory

Year of study. 2024/2025

Semester. II

Lecturer, academic title, scientific degree, position. A.Desiatko, Associate Professor, PhD, Associate Professor of the Department of Software Engineering and Cyber Security, D.Hnatchenko, Senior Lecturer of the Department of Software Engineering and Cyber Security.

Learning outcomes. Formation of future specialists' knowledge about the main capabilities of the modern version of the popular Java EE 8 platform for programming corporate applications in the Java language. This discipline allows students to learn the principles of developing modern business-oriented applications using distributed databases, such as My SQL and Apache.

Compulsory previous educational disciplines: "Fundamentals of software engineering", "Object-oriented programming", "Java technology", "Algorithms and data structures", "Databases" and "Internet programming".

Content. The primary purpose of Java Enterprise Edition (EE). Java EE application architecture. Structure of a Java program. Integrated development environments in Java (Integrated Development Environment - IDE). Serialization is the conversion of an object into a sequence of bytes. Creating and exporting a serialized object over the network. The concept of multithreading and its necessity. Difference between processes and multithreading. General definition of a collection. Mechanism of work with collections. Creating generalizations for classes and methods. The concept of lambda expressions. Features of functional programming. Purpose of reflection. Limitations when working with reflection in Java. The JNDI service is a universal service for saving objects in a hierarchical name structure. A DataSource resource is an object that allows an application to access a database. Purpose of servlets: reading explicit data that is transferred from client forms; reading implicit data; generating results; sending explicit data to the client in the form of HTML; sending implicit data. Recommended sources and other learning resources/tools.

1. Dascher S. Architecting Modern Java EE Applications. Designing lightweight, business – oriented enterprise applications in the age of cloud, containers, and Java EE 8. / S.Dascher. – Packt, Birmingham – Mumbai, 2017. – 384 p.

2. Worburton R. Java8 Lambdas Functional Programming for the Masses/ R.Worburton – Q'reilly. 2018. –193 p.

3. Мартін Роберт С. Чистий кодер: Кодекс поведінки для професійних розробників / пер. з англ. Г. Якубовська. – Харків ВД : Фабула, 2023. – 256 с.

Planned educational activities and teaching methods. A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic, problem-based) with the use of multimedia tools and video demonstrations; practical works (traditional, training tasks, computer testing).

Evaluation methods.

– current control (computer testing, survey);

- final control ( writing exam).

#### 4.7. Name. AUTOMATION OF SOFTWARE TESTING

Type. Compulsory

Year of study. 2024/2025

Semester. II

Lecturer, academic title, scientific degree, position T. Zhirova, PhD in Education, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Formation in future specialists of the ability to evaluate and choose effective methods and models of software development, implementation, support and management of relevant processes at all stages of the life cycle; develop, analyze, substantiate and systematize software requirements; develop and evaluate software design strategies; justify, analyze and evaluate options for project solutions from the point of view of the quality of the final software product, resource limitations and other factors; ensure quality at all stages of the software life cycle, including using relevant models and evaluation methods, as well as means of automated software testing and verification; plan, organize and carry out software testing, verification and validation.

Compulsory previous educational disciplines: "Software development and testing technologies", "Object-oriented programming", "Algorithms and data structures", "Software architecture and design", "Databases".

Content. Classification of testing. Alternative and additional classifications of testing. Classification according to suitability for white and black box testing. Concept of Check-list, rules for its creation. TestCase and its life cycle. Attributes (fields) testcase. Test management tools. Planning and reporting. Test plan and test results report. Evaluation of labor costs. Testing and automation. Advantages and disadvantages of automation. Components of automation. Limitations of automation. The concept of test frameworks. Their types and types. Using Unit/TestNg. Logging in. JBehave/Cucumber framework. Working with Git version control systems. Means of processing projects using Maven. TeamCity continuous integration system. Architecture of web applications. Basics of HTML and CSS. Working with Browser Developer Tools. The basics of working with Selenium. Main components, selectors. Work with web page elements. XML, HTML, CSS. XPath queries. Page Object pattern. Selenium code execution and Browsermob Proxy. Selenide for simple and effective tests. Selenoid and Selenium Grid for building test infrastructure. Working with databases. The SQL language. CRUD. Test driven development (TDD) development technique. Behavior driven development (BDD) development technique. Introduction to Docker. Continuous integration. Jenkins.

Recommended sources and other learning resources/tools.

1. Вакалюк Т.А. Технології тестування програм: посібник. – Житомир: Вид-во ЖДУ, 2018. – 96 с.
2. Alpaev, Gennadiy Software Testing Automation Tips: 50 Things Automation Engineers Should Know 1st ed. Edition.

Planned educational activities and teaching methods.

A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic, problem-based) with the use of multimedia tools and video demonstrations; laboratory work.

Evaluation methods.

- current control (computer testing, survey);
- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.8. Name. VR TECHNOLOGIES AND 3D MODELING

Type. Optional

Year of study. 2024/2025,2025/2026.

Semester. II-III

Lecturer, academic title, scientific degree, position T.Zhirova, PhD in Education, Associate Professor of the Department of Software Engineering and Cyber Security, K.Khorolska, PhD, Senior Lecturer

Learning outcomes. As a result of studying the discipline, students should: know and systematically apply methods of analysis and modeling of the application area, identification of information needs and collection of raw data for software design; evaluate and choose methods and models of development, implementation, operation of software tools and their management at all stages of the life cycle; apply models and methods of assessment and quality assurance at all stages of the software life cycle.

Compulsory previous educational disciplines: "Object-oriented programming", "Basics of software engineering", "Web-design and web-programming".

Content. Basic concepts and definitions of virtual and augmented reality technologies: immersive, real reality, virtual reality, augmented reality, mixed reality, extended reality. The Real-Virtual Continuum: Exploring Different Levels of Immersion in Virtual Space. Blender screen. Basics of NURBS and meta-surfaces. Using NURBS to create curved surfaces. Metaballs. The effect of liquid and drops using meta-surfaces. Basic settings of materials. Diffusion. Mirror image. Materials in practice. Ramp shader. Halo settings (halo). Application of Materials. Camera tracking. Animation without deformation of objects. Graphic assignment of weights (Distribution of influence using Weight Painting). Fittings for mechanisms. Non-linear walking animation. Animation of materials,

Planned educational activities and teaching methods. The study of the discipline is conducted through lectures (auditory) and practical classes (in a computer class on a PC), which ensure the consolidation of theoretical knowledge and contribute to the assimilation of practical skills.

Evaluation methods.

- current control (testing, scientific report, synopsis check, survey, control work);
- final control (exam). lamps and environment settings. Rendering. Rendering in parts. Panoramic rendering. Output formats. Visualization of animation. Blurring of movements (Motion Blur). Creating an AVI file. Layout effect. Particle effect. Technologies for creating stereo images. Creating an anaglyph. Creating a

stereogram. The basics of working with the Unity 3D SDK. Creating a VR application using the Unity SDK. Development and creation of an augmented reality program using the ArtoolKit library. Using the Vuforia platform to create augmented reality applications with multisensory control.

Recommended sources and other learning resources/tools.

1. Mack K. Unreal Engine 4 Virtual Reality Projects / Kevin Mack, Robert Ruud. – Packt Publishing; 1 edition. – April 30, 2019 – 632 p.
2. Ruud R. Blender 3D Basics Beginner's Guide / Robert Ruud. – Packt Publishing; 2nd edition edition (August 26, 2020). – 526 p.
3. John M. Blain The Complete Guide to Blender Graphics: Computer Modeling & Animation / John M. Blain. – A K Peters/CRC Press; 5 edition (April 15, 2019). – 560 p.

Language of learning and teaching. Ukrainian

#### 4.9. Name. ARCHITECTURE AND TECHNOLOGIES OF MOBILE APPLICATION PROGRAMMING

Type. Optional

Year of study. 2024/2025,2025/2026.

Semester. II-III

Lecturer, academic title, scientific degree, position T.Zhirova, PhD in Education, Associate Professor of the Department of Software Engineering and Cyber Security

Learning outcomes. Formation of future specialists' knowledge about the peculiarities of the architecture and hardware environment of mobile devices and methods of installing mobile applications; peculiarities of the architecture of mobile devices from the point of view of programming; basic methods of developing applications for mobile devices; capabilities of the Java toolkit for developing mobile applications; architecture of the Android OS and capabilities of the toolkit for application development.

Compulsory previous educational disciplines: "Fundamentals of programming", "Object-oriented programming", "Algorithms and data structures", "Software architecture and design", "Databases", "Software testing technologies", "Operating systems".

Content. Introduction to the design and development of mobile applications for Android. A brief history of the Android OS. Android architecture. Android application architecture. Application resources. User interface. Application architecture and core components. Android application development toolkit. Creating an Android project. Navigation in AndroidStudio. Building a user interface layout. Widget attributes. Layout preview. Use of widgets in applications - connections and links. Running in an emulator. User interface. Basic concepts and connections between them. Interface definition in an XML file. Placing components on the device screen using the Layout class. Graphical capabilities of Android Studio. Determination of dimensions. Width and height of elements. Internal and external indents. LinearLayout. RelativeLayout. Gravity and layout\_gravity. TableLayout. FrameLayout. GridLayout. ConstraintLayout. ScrollView. Nested Layout. Activity



life cycle. Activity base class. Four states of activity and tracking of its changes: Active, Paused, Stopped, Inactive. Event handling of the Activity class. Working with animation in the Android OS. Use of widgets and controls. Working with the file system and data stores.

Recommended sources and other learning resources/tools.

1. Smyth N. Android Studio 3.5 Development Essentials – Java Edition: Developing Android 10 (Q) Apps Using Android Studio 3.5, Java and Android Jetpack Paperback, 2019. – 778 p.

2. Шматко О. В. Аналіз методів і технологій розробки мобільних додатків для платформи Android : навч. посіб. / О. В. Шматко, А. О. Поляков, В. М. Федорченко. – Харків : НТУ «ХПІ», 2018. – 284 с.

Planned educational activities and teaching methods. A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic, problem-based) with the use of multimedia tools and video demonstrations; practical works (traditional, training tasks, computer testing).

Evaluation methods.

– current control (testing, scientific report, synopsis check, survey, control work);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.10. Name. BIOMETRIC AUTHENTICATION TECHNOLOGIES IN INFORMATION SYSTEMS

Type. Optional

Year of study. 2024/2025,2025/2026.

Semester. II-III

Lecturer, academic title, scientific degree, position T.Franchuk, PhD in Economics, Senior Lecturer of the Department of Software Engineering and Cyber Security.

Learning outcomes. Studying the basic provisions of modern biometric technologies, mastering the methods and methodologies of creating biometric authentication systems, which allow to increase the reliability of the functioning of complex information systems.

Compulsory previous educational disciplines: "Methods and means of information protection in computer systems", "Security of information systems and networks".

Content. Biometrics, biometric technologies: basic concepts and definitions. Legal basis of application of biometric technologies in information protection. Biometric protection systems, interaction with other systems. Software tools of biometric technologies. Methods of authentication of biometric systems. Modern types of biometric technologies, positive and negative aspects of the use of each of them. Fields of application of biometric systems. Application of biometric technologies to protect modern data transmission systems. The main directions of the development of biometric technologies

Recommended sources and other learning resources/tools.

1. Царьов Р.Ю. Біометричні технології: навч. посіб./ Р.Ю. Царьов, Т. М. Лемеха. – Одеса: ОНАЗ ім. О.С. Попова. -2016. – 140 с.
2. Корченко О. Методологія розроблення нейромережових засобів інформаційної безпеки Інтернет-орієнтованих інформаційних систем: навч. посіб. / О. Корченко, І. Терейковський, А. Білощицький. – К. : ТОВ «Наш Формат». – 2016. – 249 с
3. Тарнавський Ю.А. Технології захисту інформації: підручник. -Київ: КПІ ім. Ігоря Сікорського.-2018. -162 с.

Planned educational activities and teaching methods. The study of the discipline is carried out through lectures (auditory) and laboratory classes (in a computer classroom on a PC), which ensure the consolidation of theoretical knowledge of mastering biometric authentication technologies

Evaluation methods:

- current control (written test, oral survey, independent work check);
- final control (exam).

Language of learning and teaching. Ukrainian.

#### 4.11. Name. PROTECTION OF ELECTRONIC COMMUNICATION SYSTEMS

Type. Optional

Year of study. 2024/2025,2025/2026.

Semester. II-III

Lecturer, academic title, scientific degree, position

Learning outcomes. Formation of future specialists' knowledge of information protection methods in electronic communications systems: methods and means of protection against unauthorized access; classification and principles of operation of technical and software protection means; principles of construction of the most common subsystems that ensure the security of electronic communications systems; protection technologies during data transmission; methods of hardware and software protection of wireless information transmission; data transfer protocols and possible methods of unauthorized access.

Compulsory previous educational disciplines "Security of information systems and networks", "Basics of cyber security", "Organization of computer networks".

Content. The concept of information security. Problems of information technology security. Basic concepts and definitions of comprehensive information protection. Legal bases and main provisions regarding the creation of comprehensive information protection and the complex of comprehensive information protection in Ukraine. Methods, means and measures to protect information in the electronic communications system from unauthorized access. Methods, means and measures to protect information in the electronic communications system from leakage and destruction by technical channels. Acoustic channels of information leakage. Wireless networks. Technical channels of information leakage based on embedded devices. Optical channels of information leakage. Security mechanism of computer networks. Virtual private networks.

Recommended sources and other learning resources/tools.

1. Захист систем електронних комунікацій: навч.посіб./ В.О. Хорошко, О.В. Криворучко, М.М. Браїловський та ін. – Київ: Київ. нац. торг.-екон. ун-т, 2019. – 164 с.
2. Технології захисту інформації: підручник / М.М. Браїловський, С.В. Зибін, І.В. Пискун, В.О. Хорошко, Ю.Є. Хохлачова. – К.: ЦП «Компринт», 2021. – 296 с.
3. Бурячок В.Л. Технології забезпечення безпеки мережевої інфра-структури. Підручник. / В.Л. Бурячок, А.О. Аносов, В.В. Семко, В.Ю. Соколов, П.М. Складанний. – К.: КУБГ, 2019. – 218 с.

Planned educational activities and teaching methods. A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic; problem-based); practical classes (traditional, training).

Evaluation methods:

- current control (testing; oral and written survey; performance of practical and laboratory tasks);
- final control (exam).

Language of learning and teaching. Ukrainian.

#### 4.12. Name. INTELLECTUAL PROPERTY

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. N.Daraganova, Professor, Doctor of Sciences (Law), Professor of the Department of Administrative, Financial and Information Law; A.Gurzhii, Associate Professor, PhD in Law, Associate Professor of the Department of Administrative, Financial and Information Law.

Learning outcomes. Acquaintance with the norms of international and national legislation in the field of intellectual property; mastering the legal mechanisms of registration, implementation and protection of intellectual property rights. Formation of skills to carry out professional activities, as well as practical application of regulatory and legal acts. The ability to realize one's rights and responsibilities as a member of society, to be aware of the values of civil (democratic) society, the rule of law, the rights and freedoms of a person and a citizen in Ukraine. The ability to associate oneself as a member of civil society, to understand and be able to use one's own rights and freedoms, to show respect for the rights and freedoms of others.

Compulsory previous educational disciplines. "Theory of the State and Law", "Civil Law".

Content. Concept of intellectual property, objects and subjects of intellectual property. Concepts, principles and sources of copyright; objects and subjects of copyright; personal non-property and property rights to works of literature, art and science; collective management of copyrights; liability for copyright infringement. Legal protection of related rights. Concepts and conditions of legal protection of inventions, utility models, industrial designs. Legal protection of non-traditional

intellectual property results. Legal protection of means of individualization of subjects of economic turnover, goods, works and services. Concept and legal protection of commercial (brand) names; trademark and geographical meanings. Protection against unfair competition. Liability for infringement of intellectual property rights.

Recommended sources and other learning resources/tools.

1. Право інтелектуальної власності: підручник / за заг.ред.О.І.Харитонов. – Київ: Юрінком Інтер, 2019. – 540 с.

2. Інтелектуальна власність: навч. посібн. / за ред. О.В. Нестерцової-Собакаръ. – Київ: Дніпро, 2018. – 140 с.

3. Право інтелектуальної власності : підручник. / [О. І. Харитонов, Є. О. Харитонов, Т. С. Ківалова, В. С. Дмитришин, О. О. Кулініч, Л. Д. Романадзе та ін.] за заг. ред. О. І. Харитонової, 2018. – К.: Юрінком Інтер. – 367 с.

Planned educational activities and teaching methods. A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (overview / thematic); seminar / practical classes.

Evaluation methods:

– current control (testing, oral/written survey, solving legal problems, etc.);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.13. Name. INFORMATION TECHNOLOGIES IN THE SYSTEM OF ENSURING THE ECONOMIC SECURITY OF THE STATE

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. V.Tokar, Professor, Doctor of Sciences (Economics), Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. As a result of studying the discipline, students should know: the content of the main concepts of the course: "security", "economic security", "economic security of the state", etc.; basic principles and concepts of ensuring the economic security of the state using information technologies; basic methods of assessment and analysis of threats to economic security at the micro, macro and global levels; the main methods and method of calculating the threshold values of indicators of economic security of the state; principles of formation and strategies for ensuring economic security with the use of information technologies at the national, regional and global levels; methodological approaches to the analysis and assessment of the level of economic security at the micro, macro and global levels; must be able to: search for and process information about threats to economic security at the micro, macro, and global levels; apply mathematical methods for data analysis and processing in order to assess the level of economic security of the state; conduct an

analysis of the economic security of the state by individual components; use existing software solutions to simplify calculations.

Compulsory previous educational disciplines. "Algorithmization and programming", "Object-oriented programming", "Basics of databases and DBMS", "Software development and testing technologies", "WEB-design and WEB-programming".

Content. The relationship between the concepts of risk and threat. Classification of threats. The genesis of the concept of security. The concept of economic security. Hierarchy of the concept of economic security. Components of economic security. The concept of economic security of the state. Components of economic security of the state. Macroeconomic security of the state. Foreign economic security of the state. Scientific and technological security of the state. Energy security of the state. Social security of the state. Demographic security of the state. Food security of the state. Industrial safety of the state. The essence of financial security. Components of financial security. Levels of financial security. The concept of global financial security. Tax evasion in a global dimension. The global shadow financial sector. Offshore schemes. Money laundering and terrorist financing financing schemes. The concept of an indicator of economic security of the state. Classification of economic security indicators of the state. Threshold values. An integral indicator of the state's economic security. Expert methods of assessing the level of economic security of the state. Correlation-regression analysis in assessing the economic security of the state. Indicative method of assessing the economic security of the state. The system of ensuring economic security. The essence of the system of ensuring the economic security of the state. The structure of the system of ensuring the economic security of the state. Subjects of ensuring the economic security of the state. Methods of minimizing and neutralizing threats to the economic security of the state. Concept of economic security of Ukraine. Assessment of the level of provision of the components of economic security of Ukraine.

Recommended sources and other learning resources/tools.

1. Токар В.В. Інноваційно-інвестиційна діяльність промислових підприємств та економічна безпека України: навч.посіб. - Київ: ТОВ "ПанТот", 2020. - 305 с. ISBN 978-966-1531-33-7/

2. Мельникова О.П. Економічна інформатика: навч.посіб. - Київ: Центр навчальної літератури, 2019 - 424 с.

3. Хорошко О.В., Криворучко О.В., Браїловський М.М. та ін. Захист систем електронних комунікацій: навч.посіб. - Київ: Київський національний торговельно-економічний університет, 2019. - 164 с.

Planned educational activities and teaching methods. The study of the discipline is conducted through lectures (auditory) and laboratory classes (in a computer classroom on a PC), which ensure the consolidation of theoretical knowledge and contribute to the assimilation of practical skills.

Evaluation methods:

– current control (testing, scientific report, synopsis check, survey, control work);  
- final control (exam).

Language of learning and teaching. Ukrainian, English.

#### 4.14. Name. IT LAW

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. V. Timashov, Associate Professor, Doctor of Sciences (Law), Professor of the Department of Administrative, Financial and Information Law.

Learning outcomes. Formation of professional knowledge and skills in the application of legal norms regulating relations between participants in the IT sphere.

Compulsory previous academic subjects. "Constitutional law", "Civil law".

Content. The concept of IT law, its scope and structure. Legal features of opening an IT business in Ukraine. Opening of IT companies in Ukraine. Goals and limitations of international IT business structuring. Legislative regulation of electronic commerce in Ukraine. Legal responsibility for using false information on the Internet. The procedure for registering a copyright on a computer program. Copyrights in the creation of computer code and software. Contractual legal relations in the field of IT Law. Legal regulation of a startup in Ukraine. Confidentiality and ways to protect commercial secrets under the DNA contract. Ensuring the right to privacy when using information technologies. Legal problems of regulating relations in social networks. International legislation in the field of intellectual property protection.

Recommended sources and other learning resources/tools.

1. Основи ІТ-ПРАВА: навчальний посібник / Т. В. Бачинський, Р.І. Радейко, О.І. Харитоновна та ін.; за заг. ред. Т.В. Бачинського. 2-ге вид., допов. і перероб. Київ: Юрінком Інтер, 2019. – 208 с.

2. Бачинський Т. Основи ІТ-права: навч.посіб. Львів: Априорі, 2018. – 36 с.

3. Кульчій О. О. Інформаційне право : навч.посіб. / О. О. Кульчій. Полтава: ВНЗ Укоопілкі «Пулет», 2018. – 193 с.

Planned educational activities and teaching methods. Combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (overview); seminar and practical classes (training / presentation / discussion / simulation of situations / work in small groups / other); independent work, consultations.

Evaluation methods:

– current control (testing, oral / written survey, checking the prepared essay / etc.);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.15. Name. METHODS AND MEANS OF INFORMATION PROTECTION IN COMPUTER SYSTEMS

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. L.Vlasenko, Associate Professor, PhD in Technical Sciences, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Formation of theoretical knowledge and practical skills necessary for effective protection of information in computer systems.

Compulsory preliminary educational disciplines: "Life safety and labor protection", "Higher mathematics", "Computer architecture", "Operating systems", "Probability theory and mathematical statistics", "Security of information systems and networks".

Content. Security management tools in operating systems. Administration in the operating system. Security templates. Group and local security policies in the Windows operating system. Security tools in UNIX-like operating systems. Encryption algorithms. Block and stream ciphers. Feustel's network. Architecture of block ciphers. Hash functions and hashing algorithms. Execution modes of symmetric encryption algorithms. Digital certificates in Windows. Certificate formats. Steganographic methods of information protection. Methods of embedding information in multimedia files. Signature and its properties. Authentication of electronic documents. Features of EDS encryption. DSA digital signature algorithm. Standard for EDS procedures. Organizational provision of digital signature. EDS composition. EDS application technology. EDS usage schemes. Public key infrastructure. Purpose and functions of the Certification Center. Electronic certificate. Rules for the use and storage of EDS. Principles of key generation, distribution and storage. The Law of Ukraine "On Electronic Digital Signature". Crypto providers in the Windows system. Use of CRYPTOAPI functions for data encryption and decryption. Use of CRYPTOAPI functions to obtain and verify an electronic digital signature.

Recommended sources and other learning resources/tools.

1. Закон України «Про основні засади забезпечення кібербезпеки України.» Відомості Верховної Ради (ВВР), 2017, № 45
2. Остапов С. Е., Євсєєв С. П., Король О. Г., Технології захисту інформації. Навчальний посібник. Чернівці. – Видавничий дом «Родовід», 2017. – 471с.
3. Гончарова Л. Л. Основи захисту інформації в телекомунікаційних та комп'ютерних мережах. Посібник. / Л. Л. Гончарова, А. Д. Возненко, О. І. Стасюк, Ю. О. Коваль – К., 2019. – 435 с., іл.160.

Planned educational activities and teaching methods. A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic; problem-based); practical classes (traditional, training).

Evaluation methods:

- current control (testing; oral and written survey; performance of practical and laboratory tasks);
- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.16. Name. ENTERPRISE INFORMATION SYSTEM PROGRAMMING AND ADMINISTRATION

Type. Optional

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. K.Palaguta, Associate Professor, PhD in Economics, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. As a result of studying the discipline, students should know: DevOps, Agile system development methodologies; purpose, types of version control systems (SCM), concept and architecture of SCM Git; capabilities of the integrated development environment IntelliJ IDEA; the technology of using the Java programming language for system development; be able to: apply SCM Git: work with commits, branches, local and remote repositories; apply ISR IntelliJ IDEA: use autocompletion, code analysis tools, refactoring tools, tools for working with databases and SQL files, tools for launching tests and code coverage analysis, integrating with version control systems; apply the Java object-oriented programming language to develop an information system, work with databases in applications created on the Java platform; use the Java programming language to develop Internet applications.

Compulsory previous educational disciplines: "Basics of software engineering", "Object-oriented programming", "Software architecture and design", "Java technology".

Content. DevOps systems development methodology: purpose, set of tools, advantages, comparison with Agile. Version Control System (SCM): purpose, general information, types of version control systems, common SCM. SCM Git: Git concept and architecture, making changes to files, undoing changes, ignoring files, traversing the commit tree, branching, merging branches, creating and using remote repositories. Integrated development environment IntelliJ IDEA. Features overview, system requirements, comparison with Eclipse. Using autocompletion, code analysis tools, refactoring, tools for working with databases and SQL files, tools for running tests and code coverage analysis. Integration with version control systems. Development of an information system on the Java platform. Objects, classes and packages in Java. Error handling, exceptions, debugging. Input-output, access to the file system. Generics. Collections. Streams. Web server operation. User authorization. Work with databases. Asynchronous interaction with the browser. Work with XML. Testing. Multithreading.

Recommended sources and other learning resources/tools.

1. Hill A. Complete figma tutorial for ui/ux: the comprehensive beginners to expert guide for learning and mastering FIGMA for UI/UX with pictures and illustrations. Independently Published, 2022.
2. Nielsen norman group: UX training, consulting, & research. Nielsen Norman Group. URL: <https://www.nngroup.com/>



3. Staiano F. Designing and Prototyping Interfaces with Figma: Learn essential UX/UI design principles by creating interactive prototypes for mobile, tablet, and desktop. Packt Publishing, 2022. 382 p.

Planned initial entries and deposit methods. The training is carried out in a series of lectures (classroom), practical classes (in a computer class on a PC), which ensures the consolidation of theoretical knowledge and the acquisition of practical skills.

Evaluation methods:

- current control (testing, scientific report, review of notes, survey, test);
- final control (exam).

Language of learning and teaching. Ukrainian.

#### 4.17. Name. BASICS OF CYBER DIPLOMACY IN ENGLISH

Type. Optional

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. O.Haiduk, Senior Lecturer of the Department of Software Engineering and Cybersecurity

Compulsory previous academic subjects. "Sociotechnical cyber security", "Organization of computer networks", "Security of information systems and networks".

Content. Introduction to cyber diplomacy. Cyber security as a component of national security. International law and norms of state behavior in cyberspace. Institutional structure of cyber diplomacy and its economic and financial content. Regulatory and legal framework for cyber diplomacy of the leading states. Use of information and communication technologies in public diplomacy. Cyber threats and models of cyber conflicts. International cooperation in the field of cyber security. Cybercrime and cyberterrorism. Cyber espionage and cyber intelligence. Economic aspects of cyber diplomacy. Cyber security of critical infrastructure. Cyber dialogue as a tool of cyber diplomacy. Prospects for the development of cyber diplomacy.

Recommended sources and other educational resources / tools.

1. Cyberdiplomacy: Managing Security and Governance Online. Shaun Riordan. – Polity, 2019. – 160 p.

2. Internet Diplomacy. Shaping the Global Politics of Cyberspace. Meryem Marzouki, Andrea Calderaro. – Rowman & Littlefield Publishers, 2023. – 280 p.

3. Cyber-Diplomacy: Managing Foreign Policy in the Twenty-First Century. Edited By Evan H.Potter. – McGill-Queen's University Press, 2022. – 216 p.

Planned educational activities and teaching methods. The study of the discipline is conducted through lectures (auditory) and laboratory classes (in a computer classroom on a PC), which ensure the consolidation of theoretical knowledge and contribute to the assimilation of practical skills.

Evaluation methods:

- current control (computer testing, survey);
- final control (exam).

Language of learning and teaching. English

#### 4.18. Name. MULTIMEDIA SYSTEMS DESIGN

Type. Optional

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. T.Zhirova, PhD in Education, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. As a result of studying the discipline (competency), students should know: formats of presentation, storage and transmission of multimedia information; basic algorithms for processing multimedia information and features of their software implementation; methods and algorithms for compressing video information with further optimization for multimedia publications.

Compulsory previous academic subjects. "Object-oriented programming", "Basics of software engineering", "Human-machine interaction", "Web technologies and web design".

Content. Classification and field of application of multimedia information. Methods and systems of multimedia information processing. Multimedia hardware. Control devices for multimedia systems. Recording format and audio information processing methods. Software tools for creating and processing sound. Music and speech processing. Correction. Features of digital video information processing. Graphics programming: materials and lighting, texture and operations with pixels, program optimization.

Recommended sources and other learning resources/tools.

1. Шубін І. Ю. Розробка інтерактивного медіа: Навч. Посібник / Шубін І. Ю., Груздо І. В. – Харків : ХНУРЕ., 2019 – 170 с.
2. Бондаренко М. Ф. Програмні засоби створення мультимедіа: Навч. посібник / Бондаренко М. Ф., Помазанов С. В., Шубін І. Ю. – Харків : СМІТ, 2020. – 155 с.

Planned educational activities and teaching methods. The study of the discipline is conducted through lectures (auditory) and practical classes (in a computer class on a PC), which ensure the consolidation of theoretical knowledge and contribute to the assimilation of practical skills.

Evaluation methods:

- current control (testing, scientific report, synopsis check, survey, control work);
- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.19. Name. PSYCHOLOGY OF ADAPTATION

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. M.Korolchuk, Professor, Doctor of Sciences (Psychology), Professor of the Department of Psychology, I.Mostova, PhD in Psychology, Associate Professor of the Department of Psychology,

Learning outcomes. Formation of a system of knowledge regarding the use of adaptive capabilities of the individual to ensure the preservation of working capacity and health and effective and safe activity of specialists.

Content. Theoretical and methodological foundations of the psychology of adaptation. Types, types, dynamics, criteria and limits of adaptive capabilities of specialists. Biological adaptation. Levels of social and psychological adaptation. Protective mechanisms and adaptive strategies of the individual. Content of professional adaptation. The problem of adaptation of a specialist to extreme conditions of activity. Psychological support for optimization of the adaptive capabilities of the individual. Peculiarities of student adaptation and psychological methods of its optimization to the conditions of professional and educational activity. Recommended sources and other learning resources/tools.

1. Корольчук М.С. Психофізіологія діяльності: Підручник для студентів вищих навчальних закладів. К.: Ельга, Ніка-Центр, 2015. – 400 с.

2. Психологія праці в звичайних та екстремальних умовах: навч. посіб. М. С. Корольчук, В. М. Корольчук, С.М. Миронець, Г.М. Ржевський та ін. – К. : Київ. нац. торг.-екон. ун-т, 2015. – 652 с.

3. Практична психологія. Навчальний посібник. Корольчук М.С., Корольчук В.М., Ржевський Г.М., Миронець С.М., Осьодлю В.І., Зазимко О.В. – К. : Київ.нац.торг.ун-т, 2014. – 728. с..

Planned educational activities and teaching methods. A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (overview, thematic, problem-based, lecture-conferences, lecture-discussions); practical classes (trainings, presentations, discussions, work in small groups, modeling situations, case studies).

Evaluation methods.

– current control (testing, oral / written survey, etc.);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.20. Name. BUSINESS PSYCHOLOGY

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. I.Ovdienko, PhD in Psychology, Associate Professor of the Department of Psychology, I.Lapchenko, PhD in Psychology, Associate Professor of the Department of Psychology.

Learning outcomes. In the course of studying the discipline, the student should know: psychological sources, factors, mechanisms and patterns of business development as a system; basic methods and techniques of psychological training of a businessman;

the basics of a businessman's psychological potential, methods and means of implementing his business effectiveness; efficiency factors, such as behavior, motivation, organizational skills, ethics, personal limitations that reduce work effectiveness; psychological prerequisites for the formation of business activity; the process of forming business motivation; professionally important psychological and psychophysiological qualities of a businessman; socio-psychological factors of business efficiency.

Compulsory previous academic subjects. "Social psychology", "Management psychology".

Content. Basic concepts, methodology, methods, tasks and principles of business psychology. Psychological sources, factors, mechanisms and patterns of business development as a system, as well as psychological factors of the appearance of crisis phenomena in economic relations. Psychological prerequisites for the formation of business activity. The process of forming entrepreneurial motivation; professionally important psychological and psychophysiological qualities of a businessman; socio-psychological factors of business success. The main trends and approaches in assessing the professional and business qualities of a businessman; basics of personnel selection and promotion. The main moral and ethical problems of representatives of modern business. The role and significance of communication processes in the activity of an entrepreneur; the psychological significance of business communication in achieving efficiency, the psychology of decision-making in a difficult situation.

Recommended sources and other learning resources/tools.

1. Гура Т., Романовський О., Книш А. Психологія лідерства в бізнесі: навчальний посібник. Харків : «Друкарня Мадрид», 2017. 100 с.
2. Гусєва О. Ю., Легомінова С. В., Воскобоева О. В., Ромащенко О. С., Хлевицька Т. Б. Психологія підприємництва та бізнесу: навчальний посібник. Київ: Держ. ун-т телекомунікацій, 2019. 257с.
3. Мілютіна К. Л., Трофімов А. Ю. Психологія сучасного бізнесу: Навчальний посібник. Київ: Видавництво Ліра-К, 2020. 168 с.

Planned educational activities and teaching methods.

A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (overview, thematic, problem-based, lecture-conferences, lecture-discussions); practical classes (trainings, presentations, discussions, work in small groups, simulation of situations).

Evaluation methods:

- current control – oral testing / written survey; checking the prepared essay / review / report / presentation / situational tasks (case method), etc.;
- final control - written exam.

Language of learning and teaching. Ukrainian

#### 4.21. Name. WPF-APPLICATION TECHNOLOGIES

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. N.Kotenko, Associate Professor, PhD in Education, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. As a result of studying the discipline (competency), students should know: general principles of building a user interface of computer programs; XAML markup language for creating dynamic interfaces; principles of building the user interface of programs by means of WPF; principles of interaction of application programs with relational database management systems; the structure of WPF documents and means of their protection against unauthorized changes; must be able to: create WPF programs; develop a user interface for WPF-programs of economic orientation; use the XAML language to design the interface of computer programs; configure and modify the appearance of a WPF program; develop the user interface of computer programs using various WPF page layout models; display and change data stored in databases; implement verification of entered data; create new controls for a WPF application; manage documents in WPF applications; ensure protection of documents against unauthorized changes; add graphic and multimedia support in WPF applications.

Compulsory previous academic subjects. "Algorithmization and programming", "Object-oriented programming", "Basics of databases and DBMS", "Software development and testing technologies", "WEB-design and WEB-programming".

Content. Concept of interface. The XAML language. Advantages of separating appearance and behavior. Advantages and features of WPF. Types of WPF applications. Creating the simplest WPF program. The procedure for creating a WPF program in Visual Studio. Definition in application. Selection of windows or pages. Adding controls. Building and executing a WPF program. Event processing. Event model in WPF. Event handling of WPF controls. Navigation between pages. Navigation model in WPF. Navigation by hyperlinks. Transit service. Introduction to the XAML markup language. Setting the placement of controls on the page. Content models. Classes of Headed Content Controls. Interface development using Items Controls controls. General characteristics of Items Controls. Reasons for using Windows Forms elements in WPF. Reference Windows Forms elements in a WPF application. Using Windows Forms elements in XAML. Interaction with Windows Forms elements. Debugging and modifying the appearance of the program. Create new controls. Data Binding (Data Binding). Data validation by default.

Recommended sources and other learning resources/tools.

1. Chowdhury K. Windows Presentation Foundation Development Cookbook: 100 recipes to build rich desktop client applications on Windows / K. Chowdhury , 2018. – 645 p.
2. Stephens R. WPF 3d: Three-Dimensional Graphics with WPF and C# Paperback / R. Stephens, 2018 - 417 p.
3. Nathan A. Windows Presentation Foundation Unleashed (WPF) 1st Edition / A. Nathan. – Sams, 2020. – 621 p.

Planned educational activities and teaching methods. The study of the discipline is

conducted through lectures (auditory) and laboratory classes (in a computer classroom on a PC), which ensure the consolidation of theoretical knowledge and contribute to the assimilation of practical skills.

Evaluation methods:

- current control (testing, scientific report, synopsis check, survey, control work);
- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.22. Name. WEB RESOURCE SECURITY TECHNOLOGIES

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. N.Kotenko, Associate Professor, PhD in Education, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Formation of theoretical knowledge and practical skills on the issues of web application protection, starting from the stages of intelligence and finding vulnerabilities, typical vulnerabilities of the server and client part of the web application, as well as formation of skills for finding and correcting web application coding problems.

Compulsory previous academic subjects. "Information technologies in professional activity", "WEB-design and WEB-programming".

Content. Basics of Internet Security Configuration: Hypertext Transfer Protocol; HTTPS (hypertext transfer protocol over secure sockets); SSL (Secure Sockets Layer) protocol; symmetric and asymmetric encryption; use of Simple Object Access Protocol (SOAP); SMTP protocol (Simple Mail Transfer Protocol); post office protocol (POP3); Internet Access Protocol (IMAP). Overview of web authentication technologies. Web application firewalls. OWASP Top 10 List Review. Intelligence and vulnerabilities of web applications: opening a web page/structure of the application; collection of information in web applications; Vulnerability scanning of web applications. Security of the server part of web applications: introduction of server-side vulnerabilities, SQL injection, authentication and authorization of web applications, XXE injection, SSRF-forgery of requests on the server side, business logic vulnerabilities, etc. Security of the client part of web applications: cross-site scripting (XSS), cross-site request forgery (CSRF), cross-sharing of resources (CORS), DOM-based vulnerabilities, etc. Other web application client-side vulnerabilities: unsafe deserialization, web cache poisoning, HTTP host header attacks, OAuth authentication, XML security.

Recommended sources and other learning resources/tools.

1. OWASP Top Ten. URL: <https://owasp.org/www-project-top-ten/>
2. Professional Pen Testing for Web Applications. Front Cover. Andres Andreu. Wiley India Pvt. Limited, 2019

Planned educational activities and teaching methods. A combination of traditional

and non-traditional teaching methods with the use of innovative technologies: lectures (thematic, problem-based); laboratory classes using modern interactive technologies (traditional, modeling situations); independent work; consultations

Evaluation methods:

– current control (computer testing, survey);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.23. Name. DATA ANALYSIS TECHNOLOGIES

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. A.Roskladka, Professor, Doctor of Sciences (Economics), Head of the Department of Digital Economy and System Analysis.

Learning outcomes. Knowledge of the main sections of data science. Knowledge of data processing procedures: consolidation, transformation, cleaning, data enrichment; designing the structure of data warehouses and OLAP systems; models and methods of intelligent data analysis: association, clustering, classification, regression, forecasting, data visualization; modern data analysis software. Practical skills to conduct data analysis for the discovery of knowledge, to build and research systems of intelligent data analysis when solving applied problems using modern analytical platforms Tableau and Microsoft Power BI.

Compulsory previous academic subjects. "Higher and applied mathematics", "Macroeconomic and microeconomic analysis", "Intelligent analysis of data", "Statistical analysis of economic processes", "Statistical forecasting methods".

Content. Data Science. Data consolidation. Data transformation. Search for associative rules (Rules Mining). Cluster analysis of data. Visual data analysis (Visual Mining). Analysis of text information (Text Mining). Internet data analysis (Web Mining). Data analysis in real time (Real Time Data Mining). Software analytical platforms.

Recommended sources and other learning resources/tools.

1. Гладун А.Я. Data mining: пошук знань в даних: навч.посіб. А. Я. Гладун, Ю. В. Рогушина. – Київ: АДЕФ-Україна, 2016. – 451 с.
2. Олійник А. О. Інтелектуальний аналіз даних : навч. посібн. / А. О. Олійник, С. О. Субботін, О. О. Олійник. – Запоріжжя : ЗНТУ, 2012. – 278 с.
3. Cuesta H., Kumar S. Practical Data Analysis. Birmingham : Packt Publishing Ltd, 2016. 316 p.

Planned educational activities and teaching methods. A combination of traditional and non-traditional teaching methods with the use of innovative technologies: lectures (thematic, problem-based); laboratory classes (traditional, work in small groups).

Evaluation methods:

- current control (inspection of individual tasks, testing);
- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.24. Name. MANAGEMENT OF SOFTWARE PRODUCTS

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. O.Kryvoruchko, Professor, Doctor of Sciences (Engineering), Head of the Department of Software Engineering and Cyber Security, A.Desiatko, Associate Professor, PhD, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Know the methods of implementing the strategy of the software developer's organization with the help of software projects; de jure and de facto standardized universal and special models of the life cycle of a software project; the framework structure and methods of building and applying the software project management system.

Compulsory previous academic subjects. "Basics of software engineering", "Object-oriented programming", "Java technology", "Software architecture and design", "Informatization project management", "Software standardization and metrology" and "Software project management".

Content. Basics of product IT. Spheres of food IT. Software product project team. Non-technical specialists of the software product project team. Technical specialists of the software product project team. Technical component of the software product. MVP as the basis of a software product. Decision making in digital products. Startups, IPOs and venture funds. Principles of IT product marketing. User behavior in IT. Design of software products.

Artificial intelligence as part of product IT. Global Regulations on Personal Data Protection.

Recommended sources and other learning resources/tools.

1. Курс-стажування у продуктовому ІТ «Створення та розвиток ІТ продуктів» від компанії Genesis. URL: <https://genesis.theworkademy.com/uk> (унікальний доступ для проходження курсу буде надано викладачем).
2. De Carvalho, Rogério. (2023). Designing Software Intensive Products: Integrating Engineering and Intellectual Property Management to the Development of Innovative Products. DOI: 10.1007/978-3-031-08893-3.

Evaluation methods:

- current control (survey, testing, individual project);
- final control (written exam).

Language of learning and teaching. Ukrainian



#### 4.25. Name. PHILOSOPHY OF PERSONALITY

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. A.Morozov, Professor, Doctor of Sciences (Philosophy), Professor of the Department of Philosophy, Sociology and Political Science.

Learning outcomes. The formation of the philosophical self-awareness of the personality of a specialist psychologist, the ability of theoretical research and generalization of historical, socio-cultural, ideological and axiological foundations of the formation and development of the personality.

Compulsory previous academic subjects "Philosophy", "Psychology", "Sociology".

Content. The human problem in ancient philosophy. Understanding the individual in the philosophical quests of the Christian Middle Ages. Interpretations of the human phenomenon in modern and postmodern paradigms of thinking. Existential dimensions of personality. Mystical personal experience, peak experiences and the importance of intuition in spiritual life. Consciousness, the unconscious, the brain: problems of genesis and development. Meaning and values in being a person. Humanism and trans-humanism: issues of gender and cloning

Recommended sources and other learning resources/tools.

1. Бауман З. Актуальність Голокосту. Посібник. – К., Логос, 2018. – 316 с.

2. Франкл В. Людина в пошуках справжнього сенсу. Посібник. – К., Основи, 2017. – 360 с.

3. Морозов А.Ю. Зло: метафізичні і богословські виміри. Посібник. – К., КНТЕУ, 2018. – 256 с.

Planned educational activities and teaching methods. Activities: visiting the Ukrainian National Museum of Fine Arts. General methods: the combination of the logical and historical, the method of identity-opposites. Conducting lectures, seminars using multimedia technologies.

Evaluation methods:

– current control (computer testing, survey); modular (computer testing, control work);

- final control (exam).

Language of learning and teaching. Ukrainian

#### 4.26. Name. FUNCTIONAL AND LOGICAL PROGRAMMING

Type. Optional.

Year of study. 2024/2025, 2025/2026.

Semester. II-III.

Lecturer, academic title, scientific degree, position. T.Savchenko, PhD in Technical Sciences, Associate Professor, Associate Professor of the Department of Software Engineering and Cyber Security.

Learning outcomes. Formation of the ability to algorithmic and logical thinking; motivated to choose programming languages and development technologies to solve the tasks of creating and maintaining software; theoretical knowledge and practical skills necessary for mastering the basics of functional and logical programming and solving complex and informal problems found in real economic, organizational and production systems, as well as problems of artificial intelligence using the Lisp and Prolog languages.

Compulsory previous academic subjects "Algorithms and data structures", "Databases", "Software development and testing technologies", "Expert systems".

Content. Dominant programming paradigm. The concept of functional programming. A general idea of functional programming and its application. Elementary LISP. Construction of lists. Numerical functions. Governing structures. The concept of recursion. Functional. The concept of logic programming. Fields of application of the Prolog language. Features of the Visual Prolog language. Facts and rules in Visual Prolog. Concept of arguments and predicates. Assignment of queries in Prolog. Application of high-level programming languages for building expert systems.

Recommended sources and other learning resources/tools.

1. Заяць В. М. Логічне і функціональне програмування. Системний підхід: підруч. для студентів базового напрямку підготовки «Комп'ютерні науки», «Комп'ютерна інженерія» та «Програмна інженерія» / В. М. Заяць, М. М. Заяць ; Нац. ун-т водного госп-ва та природокористування. – 2-ге вид, випр. та допов. – Рівне : НУВГП, 2020. – 421 с.

2. Месюра В. І. Функціональне та логічне програмування: посіб. / В. І. Месюра, Н. В. Лисак, О. І. Суприган ; Вінниц. нац. техн. ун-т. – Вінниця : ВНТУ, 2021. – 105 с.

3. Бадаєв Ю. І. Функціональне програмування : навч. посіб. для студ. вищ. навч. закл. / Ю.І. Бадаєв та ін. ; Нац. техн. ун-т України «Київ. політехн. ін-т». – К. : НТУУ «КПІ», 2019. – 135 с.

Planned educational activities and teaching methods.

Lectures, laboratory classes, independent work.

Evaluation methods:

– current control (survey, testing);

- final control (exam).

Language of learning and teaching. Ukrainian