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

APPROVED
Head of the admissions
committee
________ V. S. Ponomarenko
"07" ____04____ 2023.

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ ЕКОНОМІЧНИЙ УНІВЕРСИТЕТ ІМЕНІ СЕМЕНА КУЗНЕЦЯ
№02071211

PROGRAM

of the entrance exam on professional test
according to the second level of higher education "MASTER"
in the fields of knowledge 12 "Information technologies",
specialty 126 "Information systems and technologies",
educational and professional program (specialization)
"Information systems and technologies"

Kharkiv, 2023

The professional test is a comprehensive exam that includes practical tasks (three tasks of varying degrees of difficulty) according to the bachelor's program in the field of knowledge 12 "Information technologies". The tasks include questions on the following normative educational disciplines: object-oriented programming, organization of databases and knowledge, and computer design technologies.

The professional test task was created to identify the knowledge, skills, and competencies possessed by a bachelor in the field of knowledge 12 "Information technologies" (Table 1).

Table 1

Basic competences that a bachelor should possess in the field of knowledge 12 "Information technologies"

Special (professional, subject) competences
Ability to analyse the design object and subject area
Ability to design systems, communication and application software, technical means and communication and information technologies, networks and systems
Ability to develop, debug and improve computer-integrated systems software. The ability to use modern design technologies in the development of algorithmic and IT software
Ability to use modern design technologies in the development of algorithmic and IT software
Ability to manage the quality of ICT products and services throughout their life cycle
Ability to develop and use methods and mathematical and computer models of fundamental and applied disciplines for processing, analysis, synthesis and optimization of the results of professional activity, using methods of formal description of systems

STRUCTURE OF THE EXAMINATION TICKET FOR THE PROFESSIONAL TEST

Test tasks include tasks, the total score of which is 200-grade points.

CONTENT OF PROFESSIONAL ENTRANCE TESTS

Topic 1. Basic concepts of the object-oriented approach

1.1. Simple and complex software systems.

Decomposition of software systems. Methods of decomposition. Object-oriented decomposition. The concept of an object. Characteristics of the object. The concept of class. The relationship between a class and its object. Object-oriented analysis and its purpose. The concept of the subject area. The main types of requirements for the software system.

1.2. Object-oriented design.

Elements of application architecture. Definition of subject area classes. Principles of class design. Object-oriented programming. Principles of object-oriented approach: abstraction, encapsulation, hierarchy, polymorphism.

Topic 2. Introduction to the Microsoft.NET platform and the C# language

2.1. Microsoft.NET platform.

Microsoft.NET platform architecture, application development tools, program compilation and execution, base class library, and typing system.

2.2. General information about the C#:

Features of language use, alphabet, data types, comparison of value types and reference types, built-in value types, built-in reference types, one-dimensional and multi-dimensional arrays, operations, operators, program structure, comments, features of using functions, parameter transfer mechanisms, namespaces, the basics of using the .NET base class library

Topic 3. Implementation of the main concepts of object-oriented programming in the C# language

3.1. Abstract data types.

Abstract data type design. Syntax of structures and classes in C#. Class elements. Access to class elements. Reference to this. Overloading class methods.

3.2. Objects in the program.

Object creation sequence. Constructors. Basic properties of constructors.

Freeing memory. Garbage collection system. Static data and methods: purpose, properties, features of use. Aggregation relation. Implementation of aggregation in the C# language. Inheritance relationship. Inheritance syntax in C#. Initialization of the base class object. Options for using inheritance. Overriding methods. Prohibition of inheritance. String representation of the object.

3.3. Implementation of the principle of polymorphism in the C# language.

Early and late bonding. Virtual methods. Abstract classes and methods. Implementation of polymorphic behaviour based on an abstract class. Rules of application of abstract classes. Interfaces. Implementation of polymorphic behaviour based on the interface. Rules for using interfaces. Principles of operation overloading. Features of using the operator function. Indexers. Properties.

3.4. Handling of exceptional situations

Types of errors in programs. Problems with the traditional approach to error handling. Exception handling mechanism. .NET Standard Library exception classes. Exception handling syntax. Arithmetic overflow check.

Topic 4. Microsoft .NET Framework standard class libraries

4.1. Sources and consumers of data.

General information about data input-output streams. Algorithms of data input-output flows. Core classes of the .NET standard library to support data I/O.

4.2. Collections.

General information about collections. Core Elements and Data Structures of the .NET Collections Standard Library Typed Collections.

4.3. String data type.

Features of the implementation of the string data type in the .Net platform. Classes of the .NET standard library for string representation and features of their use. String formatting. Purpose and use of regular expressions. Support for regular expressions in the .NET standard library. Special characters used in regular expressions.

4.4. Attributes.

Introduction to attributes. Program elements to which attributes can be applied. Defined attributes. Using conditional compilation attributes. Compile module level attributes.

4.5. Saving and restoring the state of objects in .NET

Serialization and deserialization. "Graph" of objects during serialization. Creation of classes whose objects can be serialized. Serialization and deserialization processes. Serialization formats. Serialization and deserialization of objects in binary and XML formats.

Topic 5. Development of DLL libraries

5.1. Libraries and their use. Static and dynamic libraries. DLL libraries.

5.2. Development of a DLL library on the Microsoft .NET platform.

Topic 6. Fundamentals of event-driven programming

6.1. Delegates and events.

General information about delegates. Declaring and using delegates in C#. Anonymous methods. Group delegates. General information about events. Generating events.

6.2. The basics of using Windows Forms technology

"Traditional" programming model on the .NET platform. "Windows programming" model on the .NET platform Windows Forms technology. General structure of a graphical user interface application on the .NET platform. Developing Windows Forms applications using an integrated environment. Form-level events.

Topic 7. Development of graphical user interfaces

7.1. Fundamentals of Windows Forms application architecture.

Event model in Windows Forms. Dialogue boxes. Basic visual control elements: properties and use. "Collection" of visual form controls. Using basic visual control elements. Form components to exclude erroneous data entry by the user. Using visual controls "tree" and "table". Work with data in XML format.

7.2. Using the graphical capabilities of the Microsoft .NET platform

Features of the graphic output of data. Logical coordinate system. GDI+ namespaces. Redraw message handling. Programmatic generation of a redraw message. GDI+ graphic objects. Using brushes, pens and fonts. Work with graphic images.

Topic 8. Software product deployment

8.1. Structure of the compilation module. Private and shared compilation modules. A global cache of compilation modules.

8.2. Creation of shared compilation modules. General information about application deployment. Types of deployment. Installation and deployment projects.

Topic 9. Database systems. Basic concepts and architecture

9.1. Basic concepts of databases. Infological and datalogical levels. Three "no" rule. Concepts of "information system", "data bank" and "database". Concept of DBMS, their advantages and disadvantages.

9.2. Database architecture. Conceptual level. External level. Internal level.

Topic 10. Data models

10.1. Data modelling.

Concept of data modelling. Classification of models. Hierarchical data model. Hierarchical data structure. Operations on the hierarchical structure, its advantages and disadvantages.

Network data model. Network data structure. Operations on the network structure. Advantages and disadvantages of the network model.

10.2. Relational data model

Relational data structure. Basic concepts and definitions.

Relational algebra. Operations of relational algebra. Examples of application of relational algebra. Properties of relational algebra operations.

10.3. Semantic modelling of the subject area

Model "essence - connection". Concept of essence, properties, connection. ER modelling of the subject area. Types of ER diagrams. Types of communication on ER diagrams. Database design using the ER-modelling method.

10.4. The theory of normalization of the relational data model

Anomalies when performing operations in the database. Functional dependencies. Axiomatics of functional dependencies. Logical derivation of functional dependencies. Armstrong's axioms. Lossless decomposition. Heath's theorem. Definition of the first normal form. Incomplete functional dependencies and second normal form. Transitive dependencies and the third normal form. Boyce-Codd normal form. Multivalued dependencies. Feigin's theorem and the fourth normal form. Connection dependencies are fifth normal form. General normalization procedure. Denormalization of relations.

Topic 11. SQL language

11.1. Database schema operations. Creating a database. CREATE DATABASE statement. Creating a table. CREATE TABLE statement. Modification of the table. ALTER TABLE statement. Deleting a table. DROP TABLE statement. Deleting a database. DROP DATABASE statement.

11.2. Data retrieval tools. Basic language constructs designed to select data. Expressions, conditions, and operators. Selecting from multiple tables. Use of aggregate functions. GROUP BY, HAVING, ORDER BY phrase. Subqueries

11.3. Data manipulation tools. Adding rows to a table. INSERT statement. Updating data. UPDATE operator. Deleting rows from a table. DELETE operator.

Topic 12. Database design

12.1. Database design methodology. Stages of database design. Analysis of the subject area. Conceptual modelling of the subject area. Logical and physical design.

12.2. Functions of the database design administrator group.

Topic 13. Transactions and data integrity

13.1. Data integrity.

The concept of integrity constraints. NULL values and three-valued logic. The integrity of entities and foreign keys. Operations that violate referential integrity. Strategies for maintaining referential integrity.

Domain, attribute, tuple, relation, and database constraints. Integrity Constraints in SQL.

13.2. Transactions and data integrity. Problems of parallel operation of transactions

Concept of transaction. Properties of transactions. Implementation of transactions by means of SQL.

Concept of transaction mix. Problems of parallel operation of transactions. The problem of losing updated results. The problem of unfixed dependency (reading "dirty" data, unrepeatable reading). The problem of incompatible analysis.

Implementation of isolation of transactions by means of SQL.

Topic 14. Technologies of computer design and modelling of information systems

14.1. Composition and content of the principles of structural methods and structural analysis for IS design.

Basic ideas of structural methods. Methods of analysis of complex systems. The concept of "black box". Basic criteria of "black box" functions. The principle of hierarchy as the basic principle of building a complex system into subsystems. Building a complex system in the form of a hierarchy of "black boxes" and organizing connections between them. Classification of principles of structural analysis. Basic and non-basic principles. Principles of decomposition and hierarchical arrangement. The essence of the principles of hierarchy, decomposition, notations. Classification of structural methodologies and methods of their construction.

14.2. Classification of structural methodologies.

SADT methodologies, Gain-Sarson structural system analysis, Yodan-De Marco structural analysis and design, Jackson systems development, Varnier-Oppa structural systems development, Ward-Mellor and Hatley real-time systems analysis and design, Martin information modelling. Structure maps of Constantine and Jackson.

Concept of module, conditional and cyclic calls, conditional and iteration node, structural and procedural blocks. Concept of project specification, mini-specification. Methods of building structural methodologies and their comparative analysis.

Topic 15. The concept of the SADT methodology and the principles of SADT model construction and diagram decomposition. Purpose of the IDEF0 standard and the main components of the diagram

15.1. Basic elements and rules for building the SADT model.

Composition of SADT functional model elements: functional block and interface arcs. Purpose of interface arcs. Detailing of diagrams based on the detection of subfunctions and the use of the principle of decomposition. Concept of parent and "descendant" diagrams. The principle of inheritance of properties (arcs) of parent diagrams on decomposition diagrams. Decomposition diagram tree.

15.2. The IDEF0 standard is the development of the SADT methodology for designing systems and structural-functional modelling of processes for the automation of enterprise management tasks.

The concept of contextual and decomposed diagrams of the IDEF0 standard. The composition and purpose of the interface arcs of the IDEF0 standard diagrams. Decomposition principles and rules for using and transferring block interface arcs to lower-level diagrams. Assignment of control and input feedback and their use in IDEF0 diagrams. Notation of elements on IDEF0 diagrams of different levels of decomposition (principle of continuity).

Methods of assessing the balance of diagrams during their decomposition. Quantitative assessment of the decomposition process based on indicators of balance.

Topic 16. Standards for describing threads of works and data when applying CASE technologies

16.1. Purpose, Notation, and Structure of Data Flow Diagrams (DFDs).

Yodan and Hein-Sarson notations for modelling DFD diagrams. Peculiarities of their use in flow models. The composition and purpose of the main elements of DFD diagrams: external entities, processes, systems (subsystems), data stores, and data flows.

16.2. Principles of construction and decomposition of DFD diagrams.

Notation of DFD diagrams. Construction of a context diagram based on the definition of connections between the modelled system and the external environment. Stages of diagram construction. Principles of decomposition and construction of a hierarchy of DFD diagrams: simultaneous decomposition of data and processes, the one-time definition of the same processes, and placement of a small number of elements on one diagram.

Topic 17. CASE tools for analysis and synthesis of project solutions. Classification and characteristics of CASE-tools for automating structural methodologies of IS project development

17.1. Structure, functional features of CASE tools.

Composition of the main components of the integrated CASE package. Classification features of CASE tools. A general characteristic of CASE tools.

17.2. Characteristics of software products of CASE-tools.

Characteristics of CASE tools: AllFusion Modelling Suite, Design/IDEF, EasyCASE, Vantage Team Builder, S-Designer, SILVERRAN, Visible Analyst, Oracle Designer/2000, Ramus Educational. Means of functional, informational and dual modelling. Comparative analysis of CASE tools for IS design.

RECOMMENDED REFERENCES

1. Бази даних у питаннях і відповідях : навчальний посібник / В. В. Чубук, Р. М. Чен, JI. А. Павленко та ін. – Х.: Вид. ХНЕУ, 2004. – 288 с.

2. Касьяненко В. О. Моделювання та прогнозування економічних процесів [Електронний ресурс] / В. О. Касьяненко. – Режим доступу : http://sumdu.telesweet.net/doc/lections/Modelyuvannya-ta-prognozuvannya-eko-nomichnih-protsesiv/index.html.

3. Мінухін С. В. CASE-технології. Конспект лекцій / С. В. Мінухін. – Х. : РВВ ХНЕУ, 2005. – 162 с.

4. Мінухін С. В. Методи і моделі проектування на основі сучасних CASE-засобів / С. В. Мінухін, О. М. Беседовський, С. В. Знахур. – Х. : Вид ХНЕУ, 2008. – 272 с.

5. Об’єктно-орієнтоване програмування: конспект лекцій для студентів напряму підготовки "Комп’ютерні науки" всіх форм навчання / Ю. Е. Парфьонов, В.М. Федорченко, М. Ю. Лосєв та ін.. – Х. : Вид. ХНЕУ, 2010. – 312 с.

6. Тарасов О. В. Використання мови SQL для роботи з сучасними системами керування базами даних / О. В. Тарасов, В. В. Федько, М. Ю.

Лосєв. – Х. : Вид. ХНЕУ, 2013. – 348 с.

7. Тарасов О. В. Проектування баз даних : навч. посіб. / О. В. Тарасов, В. В. Федько, М. Ю. Лосєв. – Х. : Вид. ХНЕУ, 2011. – 200 с.

8. William Sullivan. SQL Programming & Database Management for Absolute Beginners SQL Server. – 2017.

9. William Sullivan. SQL Data Warehouse Database Management, SQL Server, Structured Query Language, Business Intelligence, Data Models: Master SQL Programming / William Sullivan. - CreateSpace Independent Publishing Platform, 2018.

10. Personal Learning System "Databases" [Electronic resource]. – Access mode: https://pns.hneu.edu.ua/course/view.php?id=7874.

11. SQL Server technical documentation. – Access mode https://docs.microsoft.com/en-us/sql/sql-server/?view=sql-server-ver15

12. SQL Server Cursors [Electronic resource]. – Access mode: https://docs.microsoft.com/en-us/sql/relational-databases/cursors?view=sql-server-ver15

13. Joins (SQL Server). – Access mode: https://docs.microsoft.com/en-us/sql/relational-databases/performance/joins?view=sql-server-ver15

14. Transact-SQL Reference (Database Engine) [Electronic resource]. – Access mode: https://docs.microsoft.com/en-us/sql/t-sql/language-reference?view=sql-server-ver15

15. What Is SQL [Electronic resource]. – Access mode: https://www.sqltutorial.org/what-is-sql/.

16. Wirth N. Algorithms and Data Structures. – Prentice Hall, 1985. – 288 p. – Access mode: http://www.inr.ac.ru/~info21/ADen/AD2012.pdf

17. Malik D. S. C++ Programming: From Problem Analysis to Program Design (MindTap Course List) 8th Edition. – Cengage Learning, 2017.

18. Stroustrup B. Programming: Principles and Practice Using C++ (2nd Edition). – Addison-Wesley Professional, 2014.

19. Python Programming for Beginners: The #1 Python Programming Crash Course for Beginners to Learn Python Coding Well & Fast (with Hands-On Exercises). – Codeone Publishing, 2022.

20. Park. Python Programming for Beginners: The Ultimate Crash Course to Learn Python in 7 Days with Step-by-Step Guidance and Hands-On Exercises. – Independently published, 2022.

21. Interactive Python tutorial [Electronic resource]. – Access mode:

https://www.learnpython.org/

22. The Python Standard Library [Electronic resource]. – Access mode: https://docs.python.org/3/library/index.html

23. Personal Learning System "Programming" [Electronic resource]. – Access mode: https://pns.hneu.edu.ua/course/view.php?id=7870.

24. C++ Language Reference [Electronic resource]. – Access mode: https://docs.microsoft.com/en-us/cpp/cpp/cpp-language-reference?view=msvc-160

25. C++ language documentation [Electronic resource]. – Access mode: https://docs.microsoft.com/en-us/cpp/cpp/?view=msvc-160

26. C++ in Visual Studio [Electronic resource]. – Access mode: https://docs.microsoft.com/en-us/cpp/overview/visual-cpp-in-visual-studio?view=msvc-160

27. Introduction to Programming Using C++ (CS101) [Electronic resource]. – Access mode: https://sites.google.com/site/cs101atjust/slides

28. Programming: Principles and Practice using C++ [Electronic resource]. – Access mode: https://stroustrup.com/PPP2slides.html.

Head of the certification commission Besedovsky O.M.