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

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

ПОГОДЖЕНО
Проректор з навчально-методичної роботи
_____ Каріна НЕМАШКАЛО

МОДЕЛЮВАННЯ ІНФОРМАЦІЙНИХ СИСТЕМ
робоча програма навчальної дисципліни (РПНД)

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

Статус дисципліни	**вибіркова**
Мова викладання, навчання та оцінювання	**англійська**

Розробник:
к.е.н., доцент — підписано КЕП — Олексій БЕСЕДОВСЬКИЙ
Завідувач кафедри
інформаційних систем _____ Дмитро БОНДАРЕНКО

Гарант програми _____ Олег ФРОЛОВ

Харків
2024

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

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

AGREED
Vice-rector for educational and methodical work

_____ Karina NEMASHKALO

IT-ENTREPRENEURSHIP

Program of the course

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

Course status	**elective**
Language	**English**

Developers:
PhD, Associate Professor digital signature Oleksii BESEDOVSKYI

Head of Information Systems Department _____ Dmytro BONDARENKO

Head of study programme _____ Oleg FROLOV

Kharkiv
2024

INTRODUCTION

Information in the world today has become one of the most important resources, and information systems (IS) have become an essential tool in almost all areas of activity. The diversity of tasks solved with the help of IS has led to the emergence of many different types of systems that differ in the principles of construction and the rules of information processing.

At the same time, IS customers began to put forward more and more requirements aimed at ensuring the possibility of integrated use of information in the management of enterprise activities. Thus, there is an urgent need to develop a methodology for building information systems. The purpose of such a methodology is to regulate the IS design process and ensure the management of this process so that the requirements for both the IS itself and the characteristics of the development process are met.

The study of the course "Information Systems Modeling" involves the acquisition of theoretical knowledge and acquisition of practical skills related to the software design stage, namely the analysis of subject areas and the construction of models based on them that describe the business processes of the enterprise, etc.

The purpose of the course " Information Systems Modeling" is to provide students with theoretical knowledge and acquire practical skills in creating models for various subject areas of information systems. The course is aimed at developing skills in analyzing, designing and optimizing information systems using modern modeling methods and languages.

The objectives of the course are:

mastering the principles of construction, purpose, elements of various methodologies for building business process models, their subprocesses, etc;

mastering the basic methods of analysis, modeling, performance evaluation and optimization of business processes using the BPMN methodology;

mastering the skills of risk assessment and change management in information systems.

The object of the course is information systems, which include various components such as hardware, software, databases, business processes, and their interaction. The course considers the structure, functions and interaction of all components of information systems in terms of their modeling.

The subject of the course is the process of developing, analyzing, implementing and managing information systems through the use of various modeling methods. The study of the course covers the creation of abstract representations of information systems components, as well as their use to solve business problems and optimize the functioning of business processes.

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

Table 1

Learning outcomes and competencies formed by the course

Learning outcomes	Competencies
LO01	GC03, GC05, GC06
LO03	GC07
LO05	GC01, GC02, SC02, SC14
LO10	GC05, GC06, SC02
LO11	SC02

where, LO01. Analyze, purpose fully search for and select in formation and reference resources and knowledge necessary for solving professional problems, taking into account modern achievements of science and technology.

LO03. Know the basic processes, phases, and iterations of the software lifecycle.

LO05. Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modelling for software development.

LO10. Conduct a pre-design survey of the subject area, system analysis of the design object.

LO11. Select input data for design, guided by formal methods of requirements description and modelling.

GC01. Ability to think abstractly, analyze and synthesize.

GC02. Ability to apply knowledge in practical situations.

GC03. Ability to communicate in the state language both orally and in writing.

GC05. Ability to learn and master modern knowledge.

GC06. Ability to search, process and analyze information from various sources.

GC07. Ability to work in a team.

SC02. Ability to participate in the design of software, including modelling (formal description) of its structure, behaviour and processes of operation.

SC14. Ability to think algorithmically and logically.

COURSE CONTENT

Content module 1. Fundamentals of information systems modeling

Topic 1: Introduction to modeling of information systems

1.1. Definition of information systems. Definition of the main components of information systems. The role of information systems in modern society. Examples of practical use of information systems.

1.2. Basic concepts and terms. Overview of basic concepts. Overview of processes and their interaction in information systems. Technological aspects of information systems.

1.3. The purpose and objectives of information systems modeling. Goals of information systems modeling. Tasks that can be solved by modeling. The relationship between models and real information systems.

1.4. Models of the life cycle of an information system. Description of information system life cycle models: advantages and risks of each model. Cases of using information system life cycle models.

Topic 2. Methodologies for modeling the subject area

2.1. IDEF0. The essence of the IDEF0 standard. Possible areas of use.

2.2. DFD (Data Flow Diagram). The essence of the DFD standard. Possible areas of use.

2.3. UML (Unified Modeling Language). Sections and types of diagrams in UML. Overview of the key elements of the class diagram. Using use case diagrams to define requirements. Using UML in software development.

2.4. ER-modeling (Entity-Relationship Modeling). Using ER-modeling in today's information systems. Integration of ER-models in information systems modeling.

2.5. BPMN (Business Process Model and Notation). The purpose of BPMN diagrams for information systems modeling. Using BPMN to automate business processes.

2.6. Other modeling methodologies (CASE tools). Overview of alternative methodologies for information modeling. Comparison of other standards with UML, IDEF0, DFD, BPMN, ER-modeling.

2.7. Analysis of the purpose and advantages of each methodology (standard). Choosing the optimal standard depending on the type of information system and modeling tasks.

Topic 3. Change management in information systems.

3.1. Development of change management strategies. Steps in developing a change management strategy in information systems. Determining the purpose and scope of changes. Assessment of the risks and benefits of implementing specific changes. Developing a plan for implementing a change management strategy.

3.2. Implementation and support of changes in information systems. Providing support for changes after implementation. Technologies for effective implementation of changes in information systems. Determining the success of the change management strategy. The role of communication and staff involvement in implementing changes.

Content module 2. Practical aspects of information systems modeling

Topic 4. IDEF0 methodology as a basis for understanding processes and their modeling.

4.1. Methods and principles of structural analysis and design.

4.2. Structure and elements of the diagram of functions in IDEF0.

4.3. Types of relationships between blocks of IDEF0 diagrams. Types of relationships between functions.

4.4. Determining the advantages of modeling functions using IDEF0. Using IDEF0 to analyze input and output flows.

Topic 5. ER-modeling as an element of IS modeling.

5.1. Definition of entities and attributes in ER-modeling.

5.2. Types of relationships between entities.

5.3. Using ER-modeling in modern information systems. Integration of ER-models in information systems modeling.

Topic 6. Data flow diagrams.

6.1. Designation of processes, flows and storages on DFD.

6.2. Levels of detail (hierarchy) and their meaning in DFD diagrams.

6.3. Relationships of DFD diagrams with diagrams in IDEF0 and IDEF1X standards.

6.4. The role of DFD in understanding and modeling data flows in the system. Using DFD to develop and improve business processes.

Topic 7. Modeling of business processes.

7.1. Business processes and their modeling. Definition and structure of business processes. Steps in building a business process model. Evaluation of the effectiveness of business processes through their models. Use of tools for analyzing and improving business processes.

7.2. Using BPMN to model business processes. The use of standard BPMN elements in business processes. Defining input and output events in a BPMN diagram. The role of resources and roles in a BPMN business process model. Practical examples of BPMN implementation for business process optimization.

Topic 8. Information systems modeling on the example of practical tasks

8.1. Solving practical problems using information systems modeling. Using modeling tools to solve specific practical problems. Comparison of different options for solving practical problems. Analysis of modeling results in solving real business problems.

8.2. Using modeling tools for real-world scenarios. Adaptation of models to the requirements of real projects. Using models to simplify management and solve real-world scenarios. Challenges and strategies for using modeling tools in real projects.

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

Table 2

The list of laboratory studies

Name of the topic and/or task	Content
Topic 4	Using IDEF0 diagrams to describe business processes
Topic 5	Using data flow diagrams (DFDs) to describe a subject area
Topic 6	Creating diagrams in the IDEF1X standard to describe the subject area
Topic 7	Modeling business processes in BPMN notation

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

Table 3

List of self-studies

Name of the topic and/or task	Content
Topic 1-8	Study of lecture material
Topic 4-7	Preparation for laboratory classes
Topic 1-8	Preparation for the exam

The number of hours of lectures, laboratory studies and hours of self-study is given in the technological card of the course.

TEACHING METHODS

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

Verbal (lecture-discussion (Topic 1, 2, 4–7), problem lecture (Topic 3, 8).

Visual (demonstration (Topic 1–8)).

Laboratory work (Topic 4–7).

FORMS AND METHODS OF ASSESSMENT

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

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

– for courses with a form of semester control as an exam: maximum amount is 60 points; minimum amount required is 35 points.

The final control includes current control and an exam.

Semester control is carried out in the form of a semester exam.

The final grade in the course is determined:

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

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

Current control: defense of laboratory work (maximum score – 28 points); group competency-based task (maximum score – 8 points); theoretical tests (maximum score – 10 points); practical control works (maximum score – 14 points).

Semester control: Exam.

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

An example of an exam card and assessment criteria.

Example of an exam ticket

Simon Kuznets Kharkiv National University of Economics
First (bachelor's) study cycle
Specialty "Software engineering"
Study program "Software Engineering"
Semester VI
Course "Information systems modeling"

EXAM TICKET № 1

Task 1 (12 points).
Input information for solving the task: exam ticket; information on the tasks.
Output information: an exam answer sheet.
The process of solving the task is regulated by: the regulations on conducting examinations; evaluation criteria.
The performer is the student.
Task:
build a contextual diagram of the solution of a set of tasks;
to develop an IDEF0 diagram A0 based on the following activities: analysis of the ticket tasks; formation of theoretical answers; solving practical tasks; formation and formatting of the answer.
For the purpose of developing an automated subsystem for accounting for the performance of examination tasks, the database server should store data on: examination tasks; disciplines; answers to tasks.

Task 2 (12 points).
Using the data from Task 1, you need to develop DFD diagrams for all the works presented in the context diagram and the level 1 decomposition diagram (A0).

Task 3 (12 points).
Develop a model of the business process "Order Fulfillment" in BPMN notation. It is necessary to build a business process from the point of view of the company that manufactures the product.
A verbal description of the business process to be modeled.
Note: regarding the performers: all work (except for those for which it is specified separately) is performed by the sales manager.
The process starts after receiving a purchase order.
Detailed information about the order is entered by the call center operator into the ERP system (15 minutes). After that, the call center operator checks the order for accuracy and completeness (5 minutes).
If the order details are incorrect (20% of cases), the call center operator generates a request to correct the order (8 minutes); after receiving the corrected order, this data must be updated (entered) into the ERP system and checked again. This is repeated until the order is correct and complete.
After that, it should check whether the ordered product is available in the warehouse (12 minutes). However, if the order is placed on a Friday evening or on a weekend, the availability check should be delayed until Monday, as the product availability information is updated every Sunday evening. The share of orders placed on Friday evening or on weekends is 15%.
If the product is in stock (0.7 probability), it will be received from the warehouse (35 minutes).
If the product is not available, the sales manager first orders the raw materials for it from the supplier (12 minutes), receives the raw materials from the supplier (26 minutes), and then the product must be manufactured by the shop floor (660 minutes). Depending on the ordered product, the raw materials must be ordered from supplier 1 (probability 0.4) or supplier 2 (probability 0.6). However, in some cases, production requires raw materials from both suppliers.
If a failure (error) occurs during the manufacturing process (2% of cases), the order must be canceled by the sales manager (9 minutes), and the received (and partially processed) raw materials must be disposed of by the workshop worker at the same time (54 minutes). In this case, the process should end unsuccessfully.
If the production is successful, the ordered product is packaged by the delivery manager (15 minutes) and sent to the customer (12 minutes).
At the same time, the invoice is sent to the customer (3 minutes). Based on this invoice, payment for the products is received from the customer.

After sending the products to the customer and receiving payment for them, the order should be closed and archived (2 minutes).
Assume that the work starts immediately after each other, unless otherwise specified in the terms and conditions. Exceptions - waiting for the product availability check in the warehouse if the order is received on Friday evening or on weekends.
The cost of each email sent is 5 hryvnias.
The hourly wage rate for a sales manager is 25 UAH; for a workshop worker - 17 UAH; for a delivery manager - 20 UAH; and for a call center operator - 12 UAH.

Task 4 (4 points).
Identify and specify the markers for the diagram built in BPMN notation according to the task.
The file must contain:

- context diagram in the IDEF0 standard;
- decomposition of the context diagram in the IDEF0 standard;
- context diagram in the DFD standard;
- decomposition of a context diagram in the DFD standard;
- diagram in the BPMN standard with paths and markers for all objects where required by the conditions.

Assessment criteria

The exam paper consists of four tasks. The final grade for the exam is the sum of the grades for each task.

The **first task** is graded from 0 to 12 points in accordance with the following criteria:

5 points	Building a context diagram in IDEF0 notation in accordance with an individual task
7 points	Building a decomposition of a contextual diagram in IDEF0 notation in accordance with an individual task

In the case when the task is completed in full, but mistakes were made in its execution, a part of the points proportional to the work done in the examination paper is deducted from the maximum score for the task, namely

for each minor error (i.e., an error that does not reflect a misunderstanding of the notation; for example, incorrect formation of the names of works, etc.), up to 0.5 points are deducted, but no more than 1.5 points for each group of homogeneous minor errors;

up to 2 points are deducted for each group of homogeneous significant errors (i.e., those that affect the correct use of IDEF0 notation; for example, the absence of all types of interface arcs, etc.

The **second task** is scored from 0 to 12 points according to the following criteria:

5 points	Building a context diagram in DFD notation in accordance with an individual task
7 points	Building a decomposition of a context diagram in DFD notation in accordance with an individual task

In the case when the task is completed in full, but mistakes were made in its execution, a part of the points proportional to the work done in the examination paper is deducted from the maximum score for the task, namely

for each minor error (i.e., an error that does not reflect a misunderstanding of the notation; for example, incorrect formation of the names of works, etc.), up to 0.5 points are deducted, but no more than 1.5 points for each group of homogeneous minor errors;

up to 2 points are deducted for each group of homogeneous significant errors (i.e., those that affect the correct use of the DFD notation; for example, incorrect definition of external entities that would contradict the requirements of the standard and the relationship with the IDEF0 standard, etc.

The **third task** is evaluated from 0 to 12 points in accordance with the following components:

2 points	Defining and displaying all the necessary tracks in the software product
10 points	Building a diagram in BPMN notation in accordance with an individual task

In the case when the task is completed in full, but mistakes were made in its implementation, a part of the points proportional to the work performed in the examination paper is deducted from the maximum score for the task, namely

for each group of homogeneous minor errors (i.e., errors that do not reflect a misunderstanding of the notation; for example, incorrect definition of gateways or actions from the point of view of the task, incorrect formation of the names of actions, lack of names of choice alternatives for gateways, etc;

for each group of homogeneous significant errors (i.e., those that affect the correct use of BPMN notation; for example, incorrect definition of the type of objects in the diagram, lack of start and end events, etc.

The **fourth task** is graded from 0 to 4 points according to the following criteria:

0 points	The task is not completed or is completely incorrect
4 points	Correct definition of markers (in accordance with the task)

In the case when the task is completed in full, but mistakes were made in its execution, a part of the points proportional to the work done in the examination paper is deducted from the maximum score for the task, namely: for each incorrectly identified or missing marker, up to 0.5 points are deducted.

RECOMMENDED LITERATURE

Main

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3. Fundamentals of business process management / M. Dumas-Menijvar, M. La Rosa, J. Mendling, H. Reijers. – Berlin : Springer, 2018. – 496 p.
4. Сучасні інформаційні технології та системи [Електронний ресурс] : монографія / Н. Г. Аксак, Л. Е. Гризун, О. В. Щербаков [та ін.] ; за заг. ред. Пономаренка В. С. —Харків : ХНЕУ ім. С. Кузнеця, 2022. — 270 с. http://repository.hneu.edu.ua/handle/123456789/29233
5. Сучасні інформаційні технології і системи: монографія / В. П. Бурдаєв, Н. Г. Аксак, М. В. Кушнарьов та ін.; за заг. ред . В. С. Пономаренка. - Харків : Вид. «Стиль-іздат», 2021. - 182 с. http://repository.hneu.edu.ua/handle/123456789/25920

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6. Kilani, Mohamed & Kobziev, Volodymyr. Methodology of Data

Collection in Information System (IS). 2022. – 144 p.

7. Alkhusaili, Majed & Qureshi, Kalim. Case Study: UML Framework of Obesity Control Health Information System. 2021. – 191 p.

8. Guide to the Business Process Management Body of Knowledge (BPM CBOK® 4.0). – ABPMP International, 2019. – 480 p.

9. Real-Life BPMN (4th Edition): Includes an Introduction to DMN / J. Freund, B. Rucker. – North Charleston: CreateSpace, 2019. – 232 p.

Information resources

10. Information Systems Courses [Electronic resource]. – Access mode: https://www.udemy.com/topic/information-systems/

11. Business Process Management BPMN [Electronic resource]. – Access mode: https://www.udemy.com/courses/search/?src=ukw&q=business+process+management+bpmn

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13. BPMN постер [Електронний ресурс]. – Режим доступу: http://www.bpmb.de/index.php/BPMNPoster.

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15. Documents Associated With Business Process Model And Notation (BPMN). Version 2.0 [Electronic resource]. – Access mode: http://www.omg.org/spec/BPMN/2.0/.

16. Learn BPM – Business Process Management training with BizAgi [Electronic resource]. – Access mode: http://www.bizagi.com/en/learning.

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