MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

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DEVELOPMENT OF COMPUTER INFORMATION SYSTEMS

Guidelines for writing a coursework
for Master's (second) degree higher education students
of speciality 122 "Computer Science",
study program "Computer Science"

Kharkiv
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The requirements regarding the topic, organization, content and design
of the coursework have been submitted. A list of typical topics recommended
for research is included.
For Master's (second) degree higher education students of speciality
122 "Computer Science" of the study program "Computer Science".

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Introduction

The coursework is one of the types of self-directed work of a student of higher education on the application of knowledge in mandatory academic disciplines when solving a specific professional task and acquiring the ability to independently work with educational and scientific literature, electronic computing equipment, using modern information tools and technologies and is the stage of obtaining Master's (second) degree education.

The guidelines for writing and design of the coursework set out the requirements for conducting scientific research in the coursework, requirements for the topic, content, scope, design and defense of the coursework.

The structure, content, and subject matter of scientific research, which are given in the guidelines, are intended for the performance of a coursework by students of speciality 122 "Computer Science" of the study program "Computer Science" of the Master's (second) degree.

Specialized training of masters in computer science is an important task for increasing the level of competence of masters who are to be engaged in research, development and operation of computer information systems that ensure the conduct and information support of scientific research. In particular, when performing work related to the development of computer information systems, IT specialists deal with a wide range of issues that cannot be considered without the creation of experimental information complexes. These complexes should ensure the implementation of works in the following directions: construction of mathematical models of objects that are part of computer information and control systems and the external environment in which they function; solving system analysis problems; solving complex tasks of synthesis of algorithms, methods, models of functioning of computer systems; implementation of mathematical and computer modeling of information systems, subsystems and processes; carrying out simulation modeling and the necessary computational experiments and analysis of the reliability of the used models and the obtained results.

The outcomes of training and competences formed by the coursework are shown in Table 1.

Table 1

Learning outcomes and competences

Learning outcomes	Competences that must be mastered by a student of higher education
LO1	SC3, SC11
LO2	GC3, SC6
LO4	SC7, SC8
LO6	SC3, SC5
LO7	GC1, SC1, SC2, SC3
LO8	GC2, SC3, SC12
LO9	SC6
LO10	SC5, SC11
LO11	GC5
LO14	SC7, SC8
LO16	GC3, SC4, SC6
LO17	GC5
LO18	GC1, GC3, GC6, SC3, SC4, SC6, SC7, SC8, SC12
LO19	GC1, GC2, GC3, GC5, GC6, SC1, SC3, SC6, SC10, SC12
LO20	GC2, GC5, GC7, SC1, SC2, SC4, SC5, SC6, SC7, SC8, SC9, SC10, SC11, SC12

Note. LO1. To have specialized conceptual knowledge that includes modern scientific achievements in the field of computer science and is the basis for original thinking and conducting research, critical understanding of problems in the field of computer science and on the border of fields of knowledge.

LO2. To have specialized computer science problem-solving skills necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures.

LO4. To manage work processes in the field of information technology, which are complex, unpredictable and require new strategic approaches.

LO6. To develop a conceptual model of an information or computer system.

LO7. To develop and apply mathematical methods for the analysis of information models.

LO8. To develop mathematical models and data analysis methods (including large ones).

LO9. To develop algorithms and software for data analysis (including large data).

LO10. To design architectural solutions of information and computer systems for various purposes.

LO11. To create new algorithms for solving problems in the field of computer science, evaluate their effectiveness and limitations on algorithm application.

LO14. To test the software.

LO16. To conduct research in the field of computer science.

LO17. To identify and eliminate problematic situations during software operation, formulate tasks for its modification or reengineering.

LO18. To collect, formalize, systematize and analyze the needs and requirements for the information or computer system being developed, operated or supported.

LO19. To analyze the current state and global trends in the development of computer sciences and information technologies.

LO20. To develop algorithms and software components of computer information systems for high-performance big data processing systems (including distributed and parallel computing) and cloud platform services.

GC1. The ability to think abstractly, analyze and synthesize.

GC2. The ability to apply knowledge in practical situations.

GC3. The ability to communicate in the national language both orally and in writing.

GC5. The ability to learn and master modern knowledge.

GC6. The ability to be critical and self-critical.

GC7. The ability to generate new ideas (creativity).

SC1. Awareness of the theoretical foundations of computer science.

SC2. The ability to formalize the subject area of a certain project in the form of an appropriate information model.

SC3. The ability to use mathematical methods to analyze formalized models of the subject area.

SC4. The ability to collect and analyze data (including large data) to ensure the quality of project decision-making.

SC5. The ability to develop, describe, analyze and optimize architectural solutions of information and computer systems for various purposes.

SC6. The ability to apply existing and develop new algorithms for solving problems in the field of computer science.

SC7. The ability to develop software according to formulated requirements, taking into account available resources and constraints.

SC8. The ability to develop and implement software development projects, including those in unpredictable conditions, with unclear requirements and the need to apply new strategic approaches, use software tools to organize teamwork on the project.

SC9. The ability to develop and administer databases and knowledge bases.

SC10. The ability to evaluate and ensure the quality of IT projects, information and computer systems of various purposes, to apply international standards for assessing the quality of software of information and computer systems, models for assessing the maturity of information and computer system development processes.

SC11. The ability to initiate, plan and implement the development processes of information and computer systems and software, including its development, analysis, testing, system integration, implementation and support.

SC12. The ability to develop, apply and integrate data processing and analysis technologies in high-performance systems and cloud platforms to ensure efficient use of computing resources of computer systems.

Therefore, students must demonstrate the ability to analyze and summarize information, draw conclusions, justify the appropriateness of the obtained results and prove their practical value.

These guidelines are intended to assist students in the high-quality completion of the coursework, "Development of Computer Information Systems", and the preparation of its technical report. This aligns with the established competencies and learning outcomes of the Master's (second) degree program in Computer Science (speciality 122 "Computer Science").

1. Tasks of the coursework

Work on the coursework contributes to the deepening and consolidation of the knowledge acquired by students during the study of academic disciplines "Methodologies of Scientific Research", "Methods of Testing and Evaluating the Quality of Software Systems", "Distributed Data Storage", "Cloud Computing", "Modern Methodologies and Environments for the Development of Computer Information Systems", "High-performance Systems for Processing and Analyzing Big Data", "Information Systems in the Organization and Management of IT Enterprises".

A coursework is a type of qualifications work designed for the formation of knowledge, abilities and skills for independent conduct of scientific research under the guidance of a scientific supervisor.

The coursework involves:

conducting an analysis, review and generalization of theoretical and practical provisions regarding processes, phenomena, management objects, which are investigated in the work;

development, modification (development) of a method, model, algorithm for justifying the proposed approach, on the basis of which the research is being conducted;

conducting the experiment and analyzing the results.

The purpose of writing a term paper is generalization and systematization of the knowledge and practical skills of students for conducting theoretical-scientific and practical research; substantiating the relevance of the research; choosing a certain approach (methodology, method, model) to solving problems; design and analysis of the obtained results.

While working on the coursework, students must consolidate the skills and abilities to work with scientific and technical, regulatory and reference literature, learn to analyze existing approaches, methods, methods and models for solving general and partial tasks in the chosen subject area; to formalize the obtained results in the form of a completed scientific study according to the provided structure and content, which meet the requirements for writing a term paper.

The main tasks of the coursework are:

• familiarization with the requirements for the organization and conduct of scientific research, preparation and design of the coursework as a type of scientific work;

• development of methods of working with sources of information and scientific and technical literature in the chosen subject area;

• substantiating the relevance, scientific and practical importance of the chosen topic;

• acquisition of knowledge and skills regarding the use of methodologies, approaches, methods and models for the performance of work tasks and preparation of theoretical and experimental results in the form of a course-work as the first stage of preparing a master's diploma work;

• acquisition of skills for independent analysis of scientific research methods using:

• modern computer information systems and technologies;

• specialized software packages, environments, platforms and languages for the development of applications, data processing software (including large ones), mobile technologies;

• acquisition of knowledge and skills regarding the justification and analysis of the obtained results which prove the relevance and reliability of the conducted research;

• acquisition of experience in publicizing the obtained results through their publication in specialized scientific publications, as well as approval at scientific and technical conferences;

• familiarization with the requirements for the preparation, registration and defense of the coursework.

Topics of the coursework correspond to the curriculum of speciality 122 "Computer Science" of the study program "Computer Science" of the Master's (second) degree.

The subject of the coursework has to meet the following requirements:

- be relevant;
- have theoretical and practical significance;
- meet the current state of development and trends in the field of computer science;
- be aimed at solving problems related to the use of modern computer information technologies and systems in various fields;
- provide for the choice of effective mathematical methods and tools for modeling complex objects and processes;
- motivate students to independently solve the set scientific and technical tasks.

The topics of the coursework are developed taking into account the requirements of the industry standards of higher education (SC, GC, learning outcomes, diagnostic tools), the content of the Master's degree "Computer Science" study program and the existing experience of managers in conducting scientific research.

When choosing the topic of the coursework, the supervisor must take into account the capabilities of a certain student in terms of the ability to perform scientific research work (to ensure the student's individual learning trajectory), his commitment to conducting scientific research within the educational components of the curriculum and EPP in the speciality "Computer Science" of the study program "Computer Science" of the Master's (second) degree.

2. Organization of execution and protection of the coursework

2.1. Organization of the coursework preparation

In accordance with the curriculum, the development, preparation and defense of the coursework by students of the Master's (second) degree is carried out in the second semester of the first year of study.

The coursework is supervised by teachers of the information systems department, who are academic supervisors of master's theses.

The student is given the right to choose the topic of the work, taking into account the topics of scientific and research works performed at the

department of information systems and subject to its agreement and approval by the head of the work.

The subject of the coursework should be aimed at conducting an in-depth analysis and development (improvement) of methods, models and technologies (tools) for conducting scientific research using modern computer information systems and technologies using modern software systems and products.

The topics of the coursework should be related to scientific research works on the department's budgetary, farm contract topics, as well as to the topic of scientific work by the teachers of the IS department as part of the study load of the second half of the day.

The subject of the coursework proposed to the student must be agreed with the academic supervisor and correspond to the subject of scientific research of the Department of Information Systems.

The task presents: the topic of the coursework, input data, content, tasks, proposed methods for solution of the problem, deadlines for completing the coursework tasks in accordance with the schedule of the educational process of masters in the speciality "Computer Science" of the study "Computer Science".

Input data for solving the work tasks are:

relevance of the chosen topic, justification of the choice of the topic;

data on the management object for which the assigned tasks are solved;

methodologies, methods, models and requirements for describing the results of theoretical and experimental research. Software support should include justification for selection of the topic and a reference to a specific software product (technology) with a description of the model or subsystem chosen for modeling and visualization of the obtained results.

The student develops the content of the coursework, which must correspond to its topic and purpose, and approves the topic of the coursework. During the performance of the work tasks, the student receives consultations, and if necessary, consults with the leading teachers of the department on certain issues related to the problem being solved – scientific, applied, and software. The order of performance of the work tasks is determined according to the approved schedule.

2.2. Organization of execution and defense of the coursework

The coursework is completed by the student independently. The course work must comply with the principles of academic integrity.

The person responsible for checking for academic plagiarism, appointed by the decision of the graduation department, carries out the check with the help of software and technical means of checking for signs of plagiarism, which are publicly available on the Internet.

At the request of the department, the educational and methodical department can carry out a check using the Internet service StrikePlagiarism.com.

The student submits the work completed in accordance with the requirements to the supervisor for review one week before the deadline for the completion and defense of the work. The design of the coursework text is performed in accordance with the standard [7].

The defense of the coursework takes place at the department of information systems in the last week of the current semester (before the beginning of the examination session).

The defense is carried out by presenting the results in the form of a presentation and directly a note of the coursework with the obtained theoretical and practical results. During the defense of the work, the student must be able to answer questions about the fulfillment of research tasks, its main results, and give an assessment of the prospects for further research directions from the point of view of preparing a master's thesis.

2.3. Supervision of the coursework

The head of the professors and associate professors of the Information Systems Department is appointed to supervise the work.

The supervisor is responsible for:

providing assistance in the preparation of the justification for the choice of the topic of the work, its relevance, object and subject, research methods;

providing assistance to the applicant in choosing and structuring the content of the work, determining the direction, drafting a task for the development of a qualification work;

providing advice to the student in the selection of materials from scientific and technical sources;

assistance to the student in selecting and obtaining the necessary additional materials to increase the effectiveness of the research;

providing assistance in the performance of work tasks within the calendar schedule;

control over the execution of individual sections of the work;

checking and editing the draft version of the coursework;

preparation of the student for a presentation at a seminar or conference.

During execution of the coursework the student must:

study the literature on the topic of the coursework;

make a preliminary plan (calendar plan) for implementation of the coursework and coordinate it with the supervisor;

coordinate the structure and content with the supervisor of the coursework;

formulate scientific and practical tasks aimed at supporting each of the components of the work that will be solved within the coursework limits;

regularly attend consultations organized by the supervisor, provide him with results (interim and final) of work on the coursework;

implement the tasks of the coursework;

get scientific and practical results for the coursework;

make at least one publication of the obtained results of the coursework in the form of abstracts of a report and/or a scientific article in a professional publication in the field of information technologies;

create a report, develop a presentation, demonstration (handout) material for defense;

provide a coursework note to the supervisor for verification, defense presentation, demonstration (handout) material, a defense report;

protect the coursework.

After conducting an analysis of literary sources on the chosen topic, the student draws up a preliminary calendar plan for the coursework, discusses and approves it with the supervisor. In the process of discussion, the initial data are clarified, the scientific components are formulated in the form of the goal, object and subject of the research, the content of the scientific and practical problems of the research is given, the corresponding scientific and practical tasks of the coursework are set and the deadlines for implementation are determined.

In case of going beyond the calendar plan, the student must cite the reasons that did not allow him to complete (defend) the coursework in

a timely manner. If these reasons are valid enough, then at the meeting of the department, a decision is made to grant the student additional terms for conducting the defense.

3. The structure, content and scope of the coursework

The coursework includes an technical report and a software product that is demonstrated at the defense. An technical report (explanatory note) in electronic form and a developed software product in the form of a video demonstrating the functionality of the developed application are submitted for protection.

The coursework is the first stage in the preparation of the master's thesis, and has the following structure:

THE INTRODUCTION.

THE MAIN PART:

    analysis of the research information base;

    theoretical foundations of research;

    experimental studies;

    analysis of the obtained results.

CONCLUSIONS.

A LIST OF THE USED SOURCES.

APPENDICES.

The volume of the coursework should be 35 – 50 pages (without appendices, in accordance with the requirements for the content of the work and agreement with the scientific supervisor of the work), the list of the used sources should be at least 15 – 20 sources with a mandatory reference to them in the main part of the work.

The processing of literary sources, methodical materials, Internet resources, other source-based sources should determine the level of study of the chosen topic, the priority direction in the research and forecasting its further development, namely:

1. Acquaintance with the content of the sources.

2. Processing of sources according to the citation principle, indicating the author (authors), the title of the work (perhaps with pages in the text).

3. Creation of an index of sources (thematic, bibliographic, etc.).

4. Generalized assessment of the processed sources and their analysis.

5. Determination of the priority path (directions) of the scientific research.

In accordance with the above, the completion of the coursework involves:

- choosing a topic and justifying its relevance;
- compilation of a list of information sources and its review and analysis;
- definition of theoretical approaches to the solution of the chosen topic;
- formulation of the goal, object, subject;
- determination of the composition of tasks;
- definition of research methodologies, models and methods;
- data preparation and experiment (calculation by a method, algorithm, developed program or using existing software (packages, frameworks, platforms, libraries, etc.));
- processing, making qualitative and quantitative analysis of theoretical and experimental research results;
- formulation of conclusions regarding the results of the conducted research;
- preparation and defense of the coursework.

The main part should contain 3 sections and reflect the main theoretical and practical results obtained during the research.

The main structural units of the technical report of the coursework with a description of the content and scope of the structural units are given in Table 2.

Table 2

The main structural units of the technical report

Section	Content	The number of pages
1	2	3
The title page	The topic of the work, information about the supervisor and the work executor	1
Tasks for the coursework	A list and content of the work tasks	1
The abstract	Brief description of the content of the technical report	1
The content		1
The introduction	*Formulation of the problem and its relevance.* Formulation of the goal, object and subject of the coursework research, the composition of the tasks to be solved	1 – 2

Table 2 (continuation)

1	2	3
1. Analysis of the problem and statement of the research tasks "The title of the topic of the work"	*Analysis of the subject area* research and formulation of the task. Justification of the choice of models and methods for solving the set tasks based on a detailed review and analysis of literary sources. Analysis of areas of application of computer information systems for solving the tasks	
1.1. Description of the problem to be solved and formulation of the scientific problem	*Meaningful wording* of the scientific task regarding the given problem, substantiation of the relevance of the research (solution) and practical significance for industries	2 – 3
1.2. Analysis of approaches, methods and models for solving research tasks	*Analysis of the state of the problem solving* (tasks) or individual tasks based on the materials from literary sources. Peculiarities and characteristics of the problem solving methods. Formulation of requirements for the results that are planned to be obtained within the framework of setting the task(s) of the research	10
1.3. Setting research objectives. Formulation of the content of the main work tasks	*Formulation of research tasks.* Formalization of task setting based on the selected approaches, general methods, mathematical methods and models. *Justification* of the selection of methods and models for solving the tasks	2
Total in section 1		**up to 15**
2. Theoretical and methodological study of solving the problem "The title of the work topic"	Theoretical basis for solving the problems (tasks) of the research. Approaches, models, algorithms, methods of solution. Selection and justification of the chosen method and description of the existing elements of novelty of the proposed approach	
2.1. Theoretical methods of solving research problems	Description of the theoretical foundations of the chosen method (methods) of solving the research tasks	4
2.2. Models, algorithms and analysis of their adequacy in solving the research tasks	Selection and detailing (modification or adaptation) of the proposed models for research. Development of algorithms and description of their main modules with analysis of the use of existing methodologies for the use of modeling tools (information technologies and systems)	

Table 2 (continuation)

1	2	3
2.3. Methodological support for the organization of research	Methodological support for conducting the research using the existing methods of conducting scientific research – statistical, simulation, discrete-event modeling, with the help of modeling packages. Description of the preparatory and main stages (plan) for conducting the experimental research	3
Total in section 2		**up to 15**
3. Experimental research and analysis of the theoretical results based on statistical and simulation methods, using the created software product (software packages, frameworks, platforms, technologies)	Justification and choice of the modeling method. Selection of modeling tools with assessment of the adequacy of the obtained results. *Description of the composition of approaches* regarding the assessment of the adequacy of models in the conditions of implementation of models by means of mathematical, simulation and statistical modeling. Analysis of the simulation results	
3.1. Modeling of the obtained theoretical research results	Justification of the modeling methods based on the proposed theoretical models, assumptions and limitations of application of these methods. Preparation of input data for experimental research. Stages of processing and analysis of the research results. Description of the work of the developed software product (used software package, framework, platform, technology)	4
3.2. Description of the simulation results	Presentation of modeling results with a brief description and their graphic visualization	6
3.3. Assessment of the adequacy of the experimental research method, model, algorithm	Assessments of the adequacy and visualization of the process of processing the results. Verification of adequacy assessments obtained on the basis of the application of the developed software product (software packages, systems) and statistical data processing tools	3
3.4. Analysis of the effectiveness of the proposed method (algorithm), other results	Analysis of the effectiveness of the proposed methods (algorithms) based on the characteristics (practical assessments of the complexity of algorithms). Peculiarities of practical implementation of these methods	1 – 2
Total in section 3		**un to 15**

Table 2 (the end)

1	2	3
Conclusions	Formulation of the obtained results of the theoretical and experimental research in accordance with the work tasks	1
A list of the used sources	15 – 20 items	2
Appendices	The content and number of pages are not regulated by volume requirements	up to 10
Total		**up to 50**

Examples of the title page and tasks for the coursework are given in appendices A and B.

4. Guidelines for the development of sections and subsections of the coursework

4.1. An abstract

An abstract is a brief description of the content of the technical report of the work, which includes the main theoretical and practical results regarding the initial familiarization with the technical report to the term paper. The abstract should be placed after the coursework task.

The abstract should contain:

• data on the coursework volume, the number of figures, tables, appendices, literary sources in the list;

• a brief description of the study:

• the purpose;

• the object and subject of research;

• research methods;

• theoretical and practical research results;

• technical and linguistic characteristics of the developed software product;

• recommendations on areas of practical use of the obtained results;

• key words.

The abstract should contain no more than 200 words.

Keywords reflect the essence of the work. They are placed after the abstract text and include 10 keywords written in a line in capital letters in the nominative case.

An example of an abstract is given in Appendix C.

The introductory part states:

- the topicality;
- a brief description of the problem;
- the research area;
- the research object;
- the subject of research;
- the goal;
- a list of tasks.

To achieve the set goal you need to solve the following tasks:

1. ...

2. ...

Research methods.

Scientific novelty.

Practical significance.

The scope and structure of the work.

The purpose of the coursework should be formulated as follows: Application... ; Increase... ; Justification... ; Reduction... ; Development... .

Achieving the goal of the work is carried out on the basis of solving the following tasks:

justification of the relevance of the chosen topic;

setting the work tasks;

analysis of problem solving methods;

development of a new method; modification, improvement, development of existing methods, models;

modeling;

development of a software product for experimental research of the theoretical results;

analysis of reliability of the results;

analysis of the obtained results from the point of view of their theoretical and practical significance.

4.2. Section 1

This section is analytical.

The purpose of section 1 is to analyze the problems of the subject area of research and formulate the work tasks.

Contentwise, it states:

• analysis of literary sources regarding the issues of scientific research;

• substantiation of the choice of models and methods for solving the set tasks based on the analysis of literary sources;

• analysis of areas of application of computer systems and technologies to solve the tasks, review of prototypes and existing analogues.

In section 1, the formulation of the research tasks is carried out, the formalization of the research task formulation is determined in the form of a method (methods), model (models) based on the analyzed approaches, methods, mathematical models. The justification of the choice of methods and models for solving the given problem is carried out.

4.3. Section 2

Section 2 is intended for formulation and description of the theoretical foundations for solving the problem(s) of the research. It is necessary to consider the existing approaches, models, algorithms, methods for solution of the problem. Section 2 considers the choice and justification of the chosen method based on the analysis carried out in section 1 of the work and the description of the existing elements of novelty of the proposed approach or differences that reflect the advantage of such an approach with the indication of characteristics and parameters that justify the possibility of checking and substantiating such advantage (advantages).

To carry out the research, the essence (level) of the novelty of the approach (modification, development, improvement) of the proposed models for the research is detailed, indicating the essence of the proposed approach.

In section 2, it is necessary to develop methods and algorithms for solving the work tasks within the framework of the solved scientific problem and their description, including the use of existing methodologies for modeling complex processes and systems using information technologies and application development technologies.

In section 2, it is possible to use modeling languages (for example, UML), which helps to improve the quality assurance of the software product being developed, with an indication of the methodology (technology) for the development of software products (for example, RUP, MSF, etc.). In this case, you need to provide diagrams of use cases, sequences, activities, states.

4.4. Section 3

Section 3 is intended for experimental research of theoretical results based on the methods of statistical, simulation modeling using the created software product or existing software packages (frameworks, platforms, technologies).

In subsection 3.1 it is necessary:

to describe the modeling method based on the proposed theoretical models, assumptions and limitations of application of these models;

to describe the process of preparation of initial (input) data;

to provide a description of the software product based on the defined requirements.

In subsection 3.2, it is necessary:

to conduct an experimental study;

to present simulation results;

to provide their graphic visualization and analysis.

In subsection 3.3 it is necessary:

to provide assessments of the adequacy and use of the proposed models during the modeling of the research tasks;

to calculate adequacy estimates based on the developed software product (software packages, etc.) and statistical data processing methods.

In subsection 3.4 it is necessary:

to conduct an analysis of the effectiveness of the proposed methods (algorithms) based on the selected metrics: time characteristics, algorithm complexity assessment, model adequacy level based on statistical indicators;

to describe the possibility and features of the practical implementation of the results at the management facility.

Software should be presented according to the following options.

1. A software product developed in-house.

Placing: a local resource; GIT (for version control), cloud service.

Requirements for the description have to comprise:

use case diagrams, sequence diagrams for individual use cases (2 – 3); a class diagram; a deployment diagram; the composition of the software architecture is two-tier or three-tier (with a database server).

Provide screenshots with a brief description of the composition and content of the interface implementation.

2. Using an existing software package, framework.

Give a brief description of the functionality, highlight the subsystems used during the application of the package.

Develop a use case diagram and a deployment diagram.

Provide screenshots demonstrating the sequence of actions of working with the package (software system) and the results obtained. Explain the components of the interface and the content of the results.

If the performance of tasks involves the use of a database, it is necessary to provide the developed logical and physical models of the database with the description of the models.

4.5. Conclusions

In the conclusions, it is necessary to cite all the results related to the fulfillment of the tasks of the scientific research which were formulated in the introduction.

Formulation of conclusions should use the following expressions:

...was analyzed;

...was justified;

...was defined;

...was chosen;

...was developed;

...was calculated;

...was used.

The conclusions should indicate the prospects for further research directions and the practical implementation of the obtained results.

4.6. A list of the used sources

Compilation of the bibliographic list of the work is carried out in accordance with [7] with a mandatory reference to each source from their list in the text of the term paper.

4.7. Appendices

The appendices include:

graphic materials and calculation results;

software product listing;

initial data for modeling (initial parameter values for optimization problems and simulation modeling).

Appendices are placed on separate pages and named as follows: Appendix A, Appendix B, etc.

5. Requirements for completing the coursework

The total volume of the technical report should not exceed 50 pages (not including appendices); the volume of appendices is no more than 20 pages. The materials of the technical report are stapled using a plastic stapler with a transparent title page.

Note: the material given in the technical report and appendices must be presented in an impersonal form.

The technical report is printed on one page of a sheet of white paper in A4 format (210 × 297 mm) in full compliance with these guidelines and requirements of DSTU [7].

The text of the technical report must be printed in Times New Roman font 14, with line spacing 1.2, left margins at least 30 mm, top and bottom margins at least 20 mm, right margins at least 15 mm.

The language of the technical report is Ukrainian or English.

The text of the technical report should be concise, clear, well-edited, with wording that does not allow ambiguity in interpretation.

In the text of the report it is not allowed:

to abbreviate the designation of physical units if they are used without numbers, except in tables and in formulas;

to use indexes of standards (DSTU etc.) without a registration number. In this case, it is necessary to write "in accordance with standards, regulatory documents, etc.".

Paragraph indents should be used to highlight parts of the text that are separated in terms of content and are connected by a common logic.

The density of the coursework text, contrast and clarity should be the same. All numbers, signs, lines, letters must be clear and uniformly black throughout the technical report.

Numbering begins with the introduction page. The number is written in Arabic numerals in the upper right corner of the page without the number symbol and a period at the end. The pages of the report should be numbered with Arabic numerals, observing the numbering throughout the text. Illustrations

and tables located on separate pages are included in the total page numbering. These pages are numbered.

Each of the structural elements of the coursework: "COVER PAGE", "ASSIGNMENT SHEET", "ABSTRACT", "THE TABLE OF CONTENTS", "INTRODUCTION", "SECTIONS 1, 2, 3", "CONCLUSIONS", "A LIST OF THE USED SOURCES" and "APPENDICES" start on a new page.

The structural elements "ABSTRACT", "CONTENTS", "INTRODUCTION", "CONCLUSIONS", "A LIST OF THE USED SOURCES" and "APPENDICES" are not numbered. An example of incorrect numbering: "1. INTRODUCTION".

The headings of the structural elements "ABSTRACT", "CONTENTS", "INTRODUCTION", "TITLE OF SECTIONS 1, 2, 3", "CONCLUSIONS" and "A LIST OF THE USED SOURCES" are printed in capital letters in the middle of the sheet and highlighted in bold without underlining and without a period at the end.

Titles and subsections must have numbered headings. Headings of subsections are printed in small letters (with the first letter capitalized) and are given with a paragraph indentation, which should be equal to 1.27 cm. The paragraph indentation must be the same throughout the text of the technical report. Do not put a period at the end of the title and subtitle.

Units should be numbered within each section, for example "2.1" means the first subsection of the second section. Items (the third level of hierarchical division) are numbered within each of the subsections, for example, "2.1.2" is the second item of the first subsection of the second section of the coursework. There should be one blank line between the heading (or sub-heading or paragraph) and the text, which separates the heading from the subheading, the subheading from the paragraph.

The name of the next subsection and the beginning of its text should be located on the same page where the previous subsection ends.

Note: It is not allowed to place the name of the section and subsection at the bottom of the page if only one line of text is located after it.

Within the boundaries of titles, a subtitle to a paragraph it is not allowed to hyphenate words.

Illustrations (drawings, diagrams, photos, graphs, etc.) are placed after the first mentioning. They must be separated by blank lines before and after the illustration and after the title of the illustration.

All illustrations must be referenced. The reference to the illustration is made as follows: Fig. 2.3. The illustration number consists of the section number and the sequence number of the illustration within that section, separated by a period. So, for example, the third illustration of the second chapter is signed as follows:

Fig. 2.3. The name of the figure

Do not put a period at the end of the name of the figure. Explanatory information (in the form of a comment) can be placed under the illustration (if necessary).

If the illustration was not created by the student, then a link to the source from which it was borrowed must be provided.

Regarding illustrations submitted in appendices: their number consists of a capital letter designating the appendix and the number of the illustration within the appendix. For example, if the illustration is presented in Appendix B, then:

Fig. B.4. The name of the figure

The same rules for creating references apply to tables and formulas given in the corresponding appendices to the coursework.

After the last page of the list of the used literature, before the appendices, you must place a blank sheet of paper, on which, in the middle, the word "APPENDICES" should be printed in capital letters. In the content of the work, you must indicate the link only to the first page of the appendices.

Appendices should be marked consecutively with capital letters of the alphabet.

Each of the appendices must start on a new sheet and have a heading. The title of the appendix is printed in the middle of the sheet on the next line after its designation, for example:

Appendix A

Appendix name

If the appendix has a continuation, then the continuation of the appendix is written from the paragraph indent of the line with the first capital letter, indicating the number of the appendix and the number of the figure, table or formula. For example, "Continuation of Appendix A", "Continuation of Fig. B.1". The end of the appendix is indicated on its last page as follows: "End of Appendix A", "End of Fig. B.1".

Appendices include materials that:

are necessary for the completeness of the coursework, but their presentation in the main part of the work may change the orderly and logical presentation of the work;

due to the large volume, specificity or form of presentation, the materials cannot be included in the main part (for example, diagrams, graphs, tables, schemes, which show the results of experimental studies and calculations, etc.), they must be referenced in the appropriate sections;

additional illustrations, etc.

In the case of repeated references in the text to illustrations, tables or formulas located within the technical report, use the form of the word "see", for example: see Fig. 2.3, see Table 1.4, see formula 1.3.

If the elements to which the reference is made are located in the appendices, then the form of the repeated reference will be as follows: see Fig. A.4, see Table B.3, see formula B.2.

Tables must be placed after the place of their first mention or on the next page of the term paper. The distance from the text of the note to the table is one line.

All tables must be referenced. The table itself and its name are separated from the main text by blank lines. The name of the table is printed in bold in the middle of the page. The name is written in lowercase letters, except for the first capital letter. Do not put periods at the end of table names.

Tables are numbered with Arabic numerals with sequential numbering within the section, with the exception of the tables listed in the appendices. The table number consists of the section number and the serial number of the table within the given section, separated by a dot. For example: Table 2.1 (that is, the first table of the second section) is designed as shown in Fig. 5.1.

Table 2.1

The name of the table

Fig. 5.1. **An example of the table design**

If the table does not fit on one sheet, then if it is transferred to another sheet, the words "Continuation of table {table number}" must be indicated.

The words about the end of the table are indicated above the last part of the table (for example, "End of table {table number}").

The text in the tables is printed in font 14, in some cases font 12 may be used.

Formulas are placed directly after the text in which they are mentioned. Formulas are separated from the text by blank lines before and after the formula.

Formulas are placed in the middle of a line and numbered within a section, for example:

$$\text{formula,} \tag{1.3}$$

where <explanation of the formula components>.

Explanations of all elements used in the formula should be given directly below the formula with an explanation of the meaning of each of them on a separate line.

The first line of the explanation begins with a new line without a paragraph indentation with the word "where", without a colon. The explanation of the meaning of each element should be given on a new line, the explanatory symbols should be written at the same distance from the edge of the sheet, equal to the first symbol.

The number of the formula consists of the number of the section and the serial number of the formula, separated by a dot. For example, formula (1.3) is the third formula of the first section.

References in the text are given as the source material is described. The form of the reference should be in square brackets indicating the serial number of the source in the list of the used literature.

For example: a description of the source material [12].

If there are several sources, the link looks like this: [2–4].

If a certain rule is cited, a specific definition of a concept is provided, etc., it is necessary to indicate on which page of the primary source it appears: [2, p. 24] or from which pages the information is given: [3, p. 9–14].

You can refer to sections, subsections, illustrations, tables, formulas, appendices, indicating their numbers. For example, "in Section 1", "see subsection 1.4", "in Fig. 1.5" or so "(see Fig. 1.5)", "in Table 2.1" or so "(see Table 2.1)", "according to formula (1.3)" or so "(see formula 2.1)", "in Appendix A" or so "(Appendix A)".

The list of sources referred to in the technical report should be given after the conclusions to the work on a new page. There should be references in appropriate places in the text. The list of the used sources is placed in the order of appearance of links in the text or placed in the following sequence:

the Constitution of Ukraine;

laws of Ukraine;

decrees of the President of Ukraine;

resolutions of the Verkhovna Rada of Ukraine;

resolutions and orders of the Cabinet of Ministers of Ukraine;

other literature in alphabetical order.

After the text of the sections is filled in, the end of all lines should be checked. In order to guarantee the placement of text elements on the same line, use a non-breaking space using the key combination <Ctrl> + <Shift> + + <Space>.

The following can not be broken by placing on different lines:

Abbreviations, names and symbols (etc., Kharkiv);

initials with surname (O. V. Kostenko);

values and units of measurement: (Fig. 4, 20th century, 25 %, 400 m);

designation of intervals of values (50 – 100 m).

If there is a typo or graphic inaccuracy in the text of the technical report or appendices, it can be corrected by cleaning it or painting it with white paint and applying the corrected text in the given place. No more than 4–5 corrections are allowed within the term paper.

6. Defense and evaluation of the coursework

The defense of the term paper is public in nature and takes place before a Committee appointed by the head of the Department of Information Systems. *The student must report the main essence of the work performed within the scope of the coursework in 7 – 8 minutes, demonstrate the obtained results in 3 – 5 minutes.*

Demonstration material must be distributed to each Committee member before the defense. All of the following questions should be reflected in the demonstration material and presentation to the defense.

The structure and content of the demonstration material and presentation before the defense must be agreed and checked by the supervisor of the coursework.

During the defense, the student must consistently state the following questions:

- the topic and relevance of the research;
- the scientific and practical task, the goal, the object and subject of the research;
- research tasks;
- research methods;
- description of the process of solving each of the set research tasks: development and testing, analysis of the obtained results and formulation of conclusions with justification of their expediency and practical value.

After the report, the student must answer the questions of the Committee members, prove the independence of the coursework and his knowledge of the issues he dealt with within the scope of the work.

The university uses a 100-point accumulative system for evaluating the learning outcomes of higher education students. The decision on the grade for the coursework is taken as the average value of the grades of all Committee members. The results of the coursework defense are announced on the same day.

The student receives an "excellent" rating (90 – 100 points) if he completed the coursework in full, in compliance with all requirements, and during the defense showed: a competent, logical presentation of the report, correct and complete answers to the questions (including non-standard), deep and complete mastery of the content of the educational material; the ability to connect theory with practice, justify his judgments, draw conclusions; possession of versatile skills, techniques and competences; the technical report fully meets the requirements for its content and design and discloses all provisions of the coursework.

The grade "good" (74 – 89 points) is assigned to the student if he completed the coursework in full, in compliance with the requirements, and during the defense demonstrated solid knowledge of the material, correctly and essentially answered the questions, correctly applied theoretical provisions when solving practical tasks, possesses the necessary skills and methods in the implementation of these. The technical report sufficiently meets the requirements and discloses the key provisions of the work.

The grade "satisfactory" (60 – 73 points) is deserved by the student who completed the coursework according to the assignment, but made

inaccuracies during the execution; during the defense, demonstrated knowledge of the main material in the amount necessary for professional activity; has mastered and acquired practical skills in the field; mainly coped with the implementation of practical tasks, but showed violations of the logical sequence in the presentation of the material, mistakes in answering questions, experienced difficulties when answering modified questions; the technical report mostly meets the requirements and discloses most of the terms of the coursework.

The grade "unsatisfactory" (up to 60 points) is assigned when the coursework does not meet the requirements, and during the defense the student showed unsystematic knowledge, lack of ability to distinguish the main and secondary, made mistakes in defining concepts; the presentation of the material was performed chaotically and uncertainly, the impossibility of applying knowledge when solving practical tasks was demonstrated. The technical report does not meet the requirements, does not sufficiently disclose the position of the coursework.

Recommended literature

Main

1. Берко А. Ю. Системи баз даних та знань. Книга 2: Системи управління базами даних та знань : навч. посіб. / А. Ю. Берко, О. М. Верес, В. В. Пасічник. – Львів : "Магнолія 2006". – 2021. – 584 с.

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Appendices

The title page

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS
Educational and Scientific Institute of Information Technologies
Department of Information Systems

COURSEWORK

ON THE TOPIC

"THE TOPIC OF THE COURSEWORK"

Speciality122 "Computer Science"
study program "Computer Science"
of the Master's (second) degree

Completed by:
Student of the 1st year __ gr. _____
Student's name and surname

The supervisor of the master's work: scientific title, scientific degree, position
Supervisor's name and surname

Kharkiv, 2025

Tasks for the coursework

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS
Educational and Scientific Institute of Information Technologies
Department of Information Systems

The task
for the coursework

Speciality 122 "Computer Science"
study program "Computer Science"
of the Master's (second) degree

Completed by:
Student of the 1st year __ gr. _____
Student's name and surname

1. The topic of the work:
2. Submission deadline: "____" _____ 2025.
3. Input data to the project:
ready-made software systems, products.
4. The content of the work:
Introduction.
Section 1.
Section 2.
Section 3.
Conclusions.
5. The list of graphic material:
_____.
The algorithm of problem solving, UML diagrams.
6. Issue date of the assignment "____" _____ 2025.

The supervisor of the master's work _____ _____
(signature) (name and surname of the supervisor)

Student _____ _____
(signature) (name and surname of the student)

An example of the abstract design

ABSTRACT

The coursework contains: _____ pages, ____ figures, 9 tables, ____ appendices, _____ sources.

The purpose of the master's work is to develop methods and algorithms.

The object is resource allocation planning processes.

The subject is methods of allocating computing cluster resources.

Research methods are methods of discrete optimization of graph structures and linear programming.

As a result of the research, the algorithms of the method of solving the problem were analyzed and a model of the distribution of computing cluster resources was built.

BPwin, Erwin, and Rational Rose packages were used **to model processes and develop database schemas**. The software implementation of the method (algorithm) is made in the C# language.

CLUSTER, DISTRIBUTED COMPUTING, TASK, RESOURCE, LINEAR PROGRAMMING.

Contents

НАВЧАЛЬНЕ ВИДАННЯ

РОЗРОБЛЕННЯ КОМП'ЮТЕРНИХ ІНФОРМАЦІЙНИХ СИСТЕМ

Методичні рекомендації
до виконання курсової роботи
для здобувачів вищої освіти
спеціальності 122 "Комп'ютерні науки"
освітньої програми "Комп'ютерні науки"
другого (магістерського) рівня

(англ. мовою)

Самостійне електронне текстове мережеве видання

Укладачі: **Мінухін** Сергій Володимирович
Задачин Віктор Михайлович
Грабовський Євген Миколайович
Чирва Юлія Євгенівна

Відповідальний за видання *Д. О. Бондаренко*

Редактор *З. В. Зобова*

Коректор *З. В. Зобова*

Подано вимоги щодо тематики, організації, змісту та оформлення курсової роботи. Уміщено список типових тем, рекомендованих для дослідження.

Рекомендовано для здобувачів вищої освіти спеціальності 122 "Комп'ютерні науки" освітньої програми "Комп'ютерні науки" другого (магістерського) рівня.