MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
«KHARKIV POLYTECHNIC INSTITUTE»

GUIDELINES
for completion of thesis
educational qualification level – Master's degree in knowledge area
12 "Information technology"
for students majoring in 121 "Software Engineering"

Approved by
by the Editorial and Publishing
Council of the University,
Protocol №1 of February 15, 2024.

Kharkiv
NTU "KHPI"
2024

Methodical instructions for the implementation of diploma works of the educational qualification level - Master in the field of knowledge 12 "Information Technology" for students of speciality 121 "Software Engineering" / compiled by. Cherednichenko O.Y., Litvinova Y.S., Shmatko O.V., Moskalenko V.V. Kopp A.M., - Kharkiv: NTU "KhPI" - 2024. – 15 pp.

Compilers:

Y. S. Litvinova,
O. Y. Cherednichenko,
O. V. Shmatko,
V. V. Moskalenko,
A. M. Kopp,

Reviewer M. A. Grynchenko

Department of Software Engineering and Intelligent Control Technologies

CONTENTS.

INTRODUCTION

The guidelines contain a description of the requirements for the mandatory structure and minimum content of explanatory notes of master's theses for students studying in the speciality 121 "Software Engineering" of the educational programme "Software Engineering".

GENERAL PROVISIONS

A qualification (diploma) thesis is a work that represents the solution of a complex research and/or innovation problem in the field of software engineering at the final stage of study [1].

Diploma thesis (DT) demonstrates the ability of a master's degree applicant to use the acquired competencies and learning outcomes in accordance with the educational and professional or educational and scientific programme. Based on the results of the thesis preparation, the student must demonstrate the acquisition of **special competencies**: the *ability to plan and perform research in software engineering and the ability to develop and implement scientific and/or applied projects in the field of software engineering.* [1].

The final master's thesis is certified to confirm that the competencies and learning outcomes acquired by the applicants meet the requirements of the higher education standard in the speciality 121 - "Software Engineering" [1] and the content of the educational programme [2]. Certification takes place through a public defence of the thesis. The applicant must logically, coherently and reasonably present his or her views on the research topic, draw conclusions, formulate proposals or recommendations for the problem solved, and **identify elements of scientific novelty of the results obtained**.

In essence, a master's thesis in the specialty 121 - "Software Engineering" of the educational scientific/professional programme "Software Engineering" should consist of **independently developed software (software) to solve research and/or innovation problems that arise in the management and functioning of organisational, technical, natural and socio-economic systems. The thesis provides: a description of the object, subject of research; the essence of the problem, existing approaches to its solution; thesis statement and general scheme of its solution; theoretical foundations of the problem; algorithmic support for solving the problem; basic requirements for the**

software implementation of the algorithmic support for solving the problem; description of the software implementation of the developed algorithmic software; software testing programme; results of numerical experiments; research results, carried out

The thesis must solve a complex software engineering problem or task and involve research and/or innovation. Master's theses performed under the educational and research programme must **demonstrate the results of their own research**, either in the subject area with the use of developed solutions or in software engineering methods for solving specialised applied problems. **In master's theses, which are performed under both educational and professional and educational and scientific study programmes, it** is **mandatory to** use mathematical methods and algorithmic principles in modelling, designing, developing and researching software to solve research and/or innovation tasks [2].

The text of the work must be written independently. Works that reveal facts of textual borrowing; use of results obtained by other authors without proper references; distortion or falsification of results are not allowed for defence. The use of methods, technical solutions, results obtained by other authors as auxiliary or initial data in the thesis must be accompanied by mandatory references to the original works. The main part of the thesis is submitted for automatic plagiarism checking through the system, which is officially used at NTU "KhPI" before submission for defence. **Establishing the fact of violation of academic integrity is the basis for non-admission to the defence or cancellation of the decision of the Examination Commission (EC) and cancellation of the diploma.**

The evaluation of the thesis (final certification) is carried out by the EC based on the results of the public defence.

The composition of the EC is determined in accordance with the Regulations on the Examination Board at the National Technical University "Kharkiv Polytechnic Institute" [3].

SECTIONS OF THE THESIS AND THEIR CONTENT

The thesis must necessarily consist of structural parts that are filled with content in accordance with the requirements given in Table 1 [4].

Table 1 - Structural parts of the thesis and their content

№	Approximate title of the of the section	Content requirements	Approximate volume
1	2	3	4
1	**Introduction**	The introduction contains the relevance of the thesis topic and defines its purpose. The relevance of the topic of the thesis is related to the relevance of the problem in the subject area, the solution of which is facilitated by the results of the diploma design assignment. The problem is a significant contradiction in the subject area of the thesis that requires immediate resolution. As the goal of the thesis, you need to define a certain economic, technological, social or other effect to be achieved as a result of the development, quality assurance, implementation and maintenance of software tools. The introduction must define the practical significance of the results of the thesis, indicate the methods of scientific research used, and the testing of the results. The elements of the approbation are the applicant's scientific publications, namely: articles in professional publications of Ukraine and/or in publications included in the Scopus or Web of Science databases; articles in English in foreign publications of the OECD (Organisation for Economic Co-operation and Development) and/or the	2-3 pp.

№	Approximate title of the of the section	Content requirements	Approximate volume
1	2	3	4
		EU (European Union), abstracts at All-Ukrainian and/or International scientific conferences; scientific papers that have been determined as winners at All-Ukrainian and/or International competitions of scientific papers of higher education applicants (young scientists). The work must be tested at the department's scientific and practical seminar. **In master's theses completed under the educational and research programme, research questions must be identified!**	
2	**Section 1** *(the title should be specific in accordance with the subject of the diploma)*	This section discusses the current state of the problem. *Paragraph 1.1* A description of the object of research is carried out, which requires a description of the organisational and functional structure of the object, material, energy and information flows, the set of goals to be achieved by the object, and its resource capabilities. *Paragraph 1.2* The essence of the problem is described, which requires a description of the contradiction that determines the relevance of the topic of the thesis, a description of existing approaches to solving the problem, and the place of the thesis in solving the problem.	5-7 pp. 5-7 pp.

№	Approximate title of the of the section	Content requirements	Approximate volume
1	2	3	4
		Paragraph 1.3 The problem of the thesis is set, which requires the formulation of a specific task, the solution of which will ensure the achievement of the goal of the thesis, the creation of a list of individual tasks, the solution of which is required to solve the problem of the thesis. The sequence of solving these tasks is set by the general scheme of solving the thesis problem.	3-5 pp.
3	**Section 2** *(the title should be specific in accordance with the subject of the diploma)*	This section discusses the theoretical foundations of solving the problem of the thesis *Paragraph 2.1* The theoretical foundations of solving the problem are determined, which include the mathematical (quantitative) formulation of the problem of the thesis, description and comparative analysis of existing methods of solving the problem. The choice of a particular method of solving the problem is justified and the theoretical foundations and features of the chosen method are determined. If the task of the thesis requires solving several problems, the mathematical formulation of these problems is carried out, the choice of the method for solving each problem is justified, and a scheme of interaction of these methods is developed in solving the task of the thesis.	5-7 pp. 5-7 pp.

№	Approximate title of the of the section	Content requirements	Approximate volume
1	2	3	4
		Paragraph 2.2 The algorithmic support for solving the problem is developed, which is a set of separate, interacting, information-related algorithms, the software implementation of which ensures the solution of the problem of the thesis. When creating the structure of algorithmic software, it is recommended to use a functional model of solving the problem (IDEF0 notation), diagrams of the main options for using the software to solve the problem of the thesis (UML notation). Each algorithm should be implemented in the form of UML diagrams (sequences, actions, states, interactions, etc.), BPMN diagrams, DFD diagrams, etc. *Paragraph 2.3* Requirements are being developed for the software implementation of algorithmic software, which provides for: - defining (in verbal form) functional and non-functional (qualitative) requirements for the software for solving the problem of the thesis; - Determining the type of reference system architecture (2- or 3-level client-server architecture, web-based, service-oriented architecture, etc.); - creating UML diagrams of the main options for using the software to solve	4-6 pp.

№	Approximate title of the of the section	Content requirements	Approximate volume
1	2	3	4
		the problem; - development of a conceptual data model (in the form of ER-diagrams) of the subject area of the thesis; - providing a meaningful description of all the main entities of the data model, their relationships and the most important attributes; - development of a logical database model; - justification of the choice of instrumental software tools to be used for the software implementation of algorithmic support for solving the problem of the thesis.	
4	**Section 3** *(the title should be specific to the subject of the diploma)*	In this section, the developed algorithmic software is implemented in software and the results of numerical experiments are obtained. *Paragraph 3.1* The software implementation is described, which requires a description of the features of the direct software implementation of the developed algorithmic software. To do this, it is necessary to describe the main software components in the form of UML class diagrams, give examples of the most important forms of graphical user interface, make a brief description of the main scenarios (modes) of solving the problem, indicate the necessary	5-7 pp.

№	Approximate title of the of the section	Content requirements	Approximate volume
1	2	3	4
		characteristics of the hardware and software platform (parameters of the central processor, memory capacity, operating systems, network protocols, etc.) *Paragraph 3.2* The article presents a test programme that requires a description of a specific research object, statistical data on its functioning and development, determination of numerical values of mathematical model parameters, and parameters for controlling the probability of solving the problem of a thesis. *Paragraph 3.3* The test results are presented, which include a description of the testing procedure, a description of the results obtained, analytical documents, etc.	4-6 pp. 3-7 pp.
5	**Section 4** *(the title should be specific in accordance with the subject of the diploma)*	*Paragraph 4.1, 4.2, etc.* The paragraphs in this section present the results of an experimental study of the software engineering method(s) used in the work. The paragraphs in this section provide an assessment of the achievement of the purpose of the thesis. **This section is mandatory for master's theses completed under the educational and research programme!**	7-10 pp.
6	**Conclusions.**	The results of the work performed are briefly presented. It indicates whether the	2-3 pp.

№	Approximate title of the of the section	Content requirements	Approximate volume
1	2	3	4
		research objective has been achieved and provides an assessment of the results. **For master's theses that have been completed under an educational and research programme, answers to research questions must be formulated.** Recommendations are given on the practical use of the results of the thesis, as well as directions for possible further work in the case of continuing education in the educational and scientific programme at the level of Doctor of Philosophy.	
7	**References**	The applicant must refer to the sources of information, materials, results and ideas from which were used in the course of the thesis. References should be made to modern publications (5-10 years old). Works that are not referenced in the text of the thesis and were not actually used should not be included in the bibliography. The list of sources of information of the thesis is made in accordance with the current standards of NTU "KhPI" **The list of sources of information should include at least 20-25 titles directly related to the topic of the** master's thesis.	*(depends on the number of sources used)*

According to Table 1, the approximate length of a master's thesis will be 50-75 pages, excluding the title page, list of documents, assignments, abstracts in Ukrainian and English, list of sources of information and appendices.

The explanatory note of the thesis is prepared in accordance with the current standards of NTU "KPI" (current templates for the explanatory note and cover sheets are available on the cloud resources of the department, access to which is provided to the performers and supervisors of theses) [4].

The structure of the thesis is recommended and may vary depending on the topic and methodology of software development. The structure of the thesis is agreed with the thesis supervisor and the guarantor of the study programme.

LIST SOURCES OF INFORMATION

1 Standard of higher education of Ukraine of the second (master's) level of the degree "master" in the field of knowledge 12 "Information technology", speciality 121 "Software engineering" [Electronic resource] - Access mode: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwif_KC_oe_8AhXiiIsKHfifCacQFnoECAkQAQ&url=https%3A%2F%2Fmon.gov.ua%2Fstorage%2Fapp%2Fmedia%2Fvishcha-osvita%2Fzatverdzeni%2520standarty%2F2020%2F11%2F17%2F121_inzheneriya_prohramnoho_zabezpechennya_mahistr.doc&usg=AOvVaw0MaENlRn4HdUqfv7cBTkg_ (accessed 27.01.2024).

2 Educational and professional programme "Software Engineering" of the second (master's) level of higher education of NTU "KhPI" [Electronic resource]: http://web.kpi.kharkov.ua/asu/121-inzheneriya-programnogo-zabezpechennya-2/ (accessed 27.01.2024).

3 Regulations on the Examination Board at the National Technical University "Kharkiv Polytechnic Institute" [Electronic resource]: http://blogs.kpi.kharkov.ua/v2/nv/wp-content/uploads/sites/17/2022/04/POLOZHENIE_PRO_YEKZKOM_2022_n.rar (accessed 27.01.2024).

4 A system of standards for the organisation of the educational process. Diploma Projects and Diploma Papers. General requirements for performance. STZVO-KHPI-2.01-2021 [Electronic resource]: http://blogs.kpi.kharkov.ua/v2/metodotdel/wp-content/uploads/sites/28/2021/12/STZVO-HPI-2.01-2021-SSONP.-Diplomni-proekti-ta-diplomni-roboti.-Zagalni-vimogi-do-vikonannya-1.pdf (accessed 27.01.2024).

Educational edition

GUIDELINES
for completion of thesis
educational qualification level – Master's degree in knowledge area
12 "Information technology"
for students majoring in 121 "Software Engineering"

Authors:
LITVINOVA Uliya Sergiivna
CHEREDNICHENKO Olga Yuriivna
SHMATKO Oleksandr Vitaliyovych
MOSKALENKO Valentyna Volodymyrivna
KOPP Andrii Mykhailovych

Responsible for the issue Assoc. Prof. Kopp A.M.
The paper has been recommended for publication by Prof. Hamaiun I.P.

Plan of 2024, pos. 149

Signed for publication on 15.02.2024.
Headset Times New Roman.
Approx. printed pages 0.35.

Publishing Centre of NTU "KhPI
Certificate of state registration DK № 5478 of 21.08.2017.
61002, Kharkiv, Kyrpychova str, 2

Independent electronic publication