

METHODICAL INSTRUCTIONS

for master's qualification thesis

for students of specialty 141 "Electric power engineering, electrical engineering and electromechanics"

(educational program "Power Plants")

Ministry of Education and Science of Ukraine
Vinnytsia National Technical University

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The guidelines address the requirements for master's qualification thesis, developed on the basis of the Regulations on Qualification Theses at the second (master's) level of higher education at Vinnytsia National Technical University. The rules of formatting, content and structure, procedure for completing and defending a master's thesis, as well as requirements for the main sections are presented. The topics of master's qualification thesis and quality assessment criteria are presented.

Methodical instructions are intended for applicants for a master's degree in higher education in the specialty 141 "Electric power engineering, electrical engineering and electromechanics", who are studying under the educational program "Power Plants".

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INTRODUCTION

Writing a qualification thesis is the final stage of students' education at VNTU at the second (master's) level of higher education, in the process of which theoretical knowledge and practical skills of students are summarized and consolidated, experience in solving engineering problems independently, and the ability to use modern achievements of science and technology in their work are gained.

The qualification thesis at the second (master's) level of higher education is a document on the basis of which the Examination Commission determines the level of theoretical and practical education of the applicant, his/her readiness for independent work in the specialty, and decides to award the applicant the educational qualification "Master of Electric Power Engineering, Electrical Engineering and Electromechanics" [1].

Master's qualification thesis (MQT) is a student's qualification thesis that synthesizes the result of theoretical and practical education within the compulsory and elective components of the educational and professional program for the training of specialists of the second (master's) level of higher education in the specialty "Electricity, Electrical Engineering and Electromechanics" and is a form of control of the integrated knowledge, skills and abilities acquired by the student in the process of studying, which are necessary to perform professional duties provided by the Standard of Higher Education of Ukraine (if developed) or educational and professional program [2].

The MQT substantiates the relevance of the research topic, formulates and reveals the scientific problem and analyzes the ways of its research. In the introductory part, it is required to define the object and subject of research. It is the results of theoretical and practical research in the master's thesis that allow the student to demonstrate the level of professional and scientific training.

The qualification thesis must be checked for textual misuse (plagiarism) using software and hardware and posted on the official website of VNTU using the JetIQ Learning Support System [2].

For the quality performance of the master's qualification thesis and successful defence, an appropriate organization is required, starting with the timely receipt of the individual task for the MQT by the student and ending with the defence of the qualification thesis.

These instructions define the competence and functional responsibilities of officials in the organization of writing and defending the MQT, procedural issues, and also regulate the basic regulatory requirements for master's qualification thesis, deadlines, and reporting features [1].

The requirements of these instructions apply to applicants of the second (master's) level of higher education of all forms of education, supervisors of qualification thesis, reviewers, members of Examination Commissions.

1 GOALS AND OBJECTIVES OF THE MASTER'S QUALIFICATION THESIS

The second (master's) level of higher education involves the acquisition by the applicant of in-depth theoretical and/or practical knowledge, skills, abilities in the chosen specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics" (educational program), general principles of scientific and/or professional activity, other competencies sufficient to effectively perform innovative tasks of the appropriate level of professional activity [1].

The goal of the Power Plants educational program is to train specialists capable of constructing, designing, operating power generation, transmission, and distribution facilities, ensuring a culture of safety, performing installation, commissioning, and repair, creating new equipment and introducing the latest technologies, conducting research, and teaching [2].

Master's qualification thesis involves conducting research and/or implementing innovations to solve an actual theoretical or applied problem, research or experimental development, in accordance with the specialty (or educational program), synthesizes the result of theoretical and practical training within the framework of the normative and variable components of a certain educational and professional program for the training of applicants for the second (master's) level of higher education and is a form of control of the knowledge acquired by the applicant during training [1].

The master's qualification thesis is developed on the basis of a larger amount of material than the bachelor's qualification thesis (project), differs in the depth of the analysis conducted and the theoretical significance of the conclusions, the practical orientation of the results obtained [1]. A master's thesis must meet the following requirements:

- correspond to the current level of science development;
- be relevant to science and practice;
- contain new material that provides for the description of new facts, phenomena and patterns or interpretation of previously known provisions from other theoretical or practical positions or in another aspect;
- have internal unity;
- be characterized by the validity of opinions and accuracy of the data provided;
- contain comprehensively reasoned and significant conclusions that are a logical conclusion of the analysis of the research material, which summarize the results of the study;
- contain results that indicate that the author has the skills of creative work in the field of electrical engineering, prove his ability to conduct independent development and research, solve specific theoretical or practical problems;

- have appropriate thesis design;
- have all the necessary supporting documents;
- be completed and submitted to the department within the timeframe provided for by the academic process schedule.

The goal of the master's qualification thesis is to master the methodology of creative solution of modern scientific and/or applied problems on the basis of the acquired knowledge and professional skills in accordance with the requirements of the educational and professional program "Power Plants" in specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics".

The tasks of writing a master's thesis are:

- systematization and deepening of theoretical knowledge in the context of solving certain practical problems in the field of electrical engineering;
- search for modern scientific achievements in the field of electrical engineering, the ability to apply them independently in solving the tasks;
- formulation of a specific applied problem that has not been sufficiently covered in the scientific literature and has not been solved in practice;
- independent substantiation of ways and means of solving this problem;
- establishing internal and external links between phenomena and processes that are essential for solving a specific practical problem;
- mastering modern research methods and computer technology;
- formulation of recommendations, proposals and conclusions based on the results of the study.

The master's qualification thesis is carried out in accordance with the areas of scientific and applied research of the Department of Electric Power Plants and Systems (PPS) and demonstrates [1]

- the level of professional training of the graduate;
- the quality of the acquired knowledge of the relevant educational and professional program;
- the ability to independently comprehend the problem, its creative research;
- ability to determine the relevance, purpose and objectives of the study;
- ability to apply modern methods to obtain and analyze empirical data;
- ability to apply the knowledge gained in a higher education institution to solve complex practical problems;
- conscious assimilation of knowledge and its systematization;
- the student has professional work skills;
- the ability to think critically and creatively, to be able to argue their own point of view;
- ability to collect, analyze and systematize scientific, regulatory and legal sources, conduct bibliographic searches using modern information technologies;
- the ability to draw up the results of theoretical calculations and practical research in accordance with modern requirements.

In order to collect factual material for the analytical part of the master's qualification thesis, the student takes a pre-diploma practice at one or more enterprises (institutions, organizations).

The MQT is performed individually on an approved topic, which is developed by the Department of Power Plants and Systems and approved by the Rector of VNTU.

2 RIGHTS AND OBLIGATIONS OF THE SUPERVISOR, CONSULTANT, OPPONENT AND HIGHER EDUCATION STUDENT DURING THE PERFORMANCE OF MASTER'S QUALIFICATION THESIS

According to the Regulations on qualification thesis at the second (master's) degree program at VNTU [1], the *supervisor of the master's thesis is obliged to:*

- to form the topics of master's qualification thesis, to submit them for approval at the meeting of the Department of Power Plants and Systems;
- prepare and issue an individual task for the master's qualification thesis to the applicant;
- to provide recommendations to the applicant on the processing of the necessary literature, regulatory and reference materials, scientific publications, etc. on the topic of the master's qualification thesis;
- monitor the implementation of the calendar plan for the master's qualification thesis);
- to carry out general supervision of the master's qualification thesis by the applicant;
- to advise the applicant on all issues related to the implementation of the master's qualification thesis;
- check the completed master's qualification thesis;
- to prepare a review with a description of the applicant's activities during the master's qualification thesis;
- prepare the applicant for the defense;
- if possible, to attend the EC meeting during the defense of master's qualification thesis, which he/she is the supervisor of.

The applicant is obliged to [1]:

- timely select the topic of the master's qualification thesis and receive a preliminary individual task for the qualification work and recommendations from the supervisor for the selection and processing of materials during the undergraduate practice;
- during the undergraduate internship, in addition to completing its program, if necessary, get acquainted with the practical implementation of the organization and management of production (enterprise, institution, etc.), labor protection, environmental protection, life safety, technical, economic and special issues related to the topic of the qualification thesis;
- after compiling and defending the report on undergraduate practice, obtain from the supervisor the final individual assignment for the qualification thesis in the prescribed form and the specified content, features and requirements for the implementation of its individual issues approved by the head of the graduating department;

- regularly, at least once a week, inform the supervisor about the status of the thesis in accordance with the calendar plan (see Appendix B), provide the necessary materials for verification at the supervisor's request;
- independently perform an individual master's qualification thesis or an individual part of a comprehensive master's qualification thesis;
- when developing issues, take into account modern achievements of science and technology, use advanced methods of scientific and experimental research, make informed and optimal decisions using a systematic approach;
- use modern computer technologies in the performance of master's qualification thesis;
- to be responsible for the correctness of decisions, justifications, calculations, quality of text and graphic material, their compliance with the methodological recommendations of the Department of Power Plants and Systems for the implementation of master's qualification works, existing regulations and standards of higher education;
- adhere to the calendar plan of the master's qualification thesis, the established rules of conduct in laboratories and classrooms, timely and adequately respond to the comments and recommendations of the supervisor and consultants of the qualification thesis;
- submit the master's qualification work for review by the supervisor and consultants within the established deadline and, after eliminating their comments, return it to the supervisor for his/her feedback;
- submit an electronic version of the master's qualification thesis to the responsible person of the graduating department for plagiarism checking within the established deadline;
- obtain all the necessary signatures on the title page of the thesis, individual assignment, in the appropriate places of the text and graphic (illustrative) parts, as well as the resolution of the head of the graduating department on admission to the defense;
- personally submit the master's qualification thesis (project), admitted to defense, to the reviewer; at his/her request, provide the necessary explanations on the issues that were developed;
- to read the content of the supervisor's feedback and review and prepare (if necessary) reasoned responses to their comments when defending the thesis at the EC. It is forbidden to make any changes or corrections to the master's qualification thesis after receiving the supervisor's feedback and review;
- by the decision of the Faculty of Electric Power Engineering and Electromechanics, the Department of Power Plants and Systems or on their own initiative and with the consent of the supervisor, undergo a preliminary defense at the department or organization where the thesis was performed;

- to submit to the Department of Power Plants and Systems a master's qualification thesis prepared and approved for defense with the feedback of the supervisor and opponent before its defense at the EC;

- in case of impossibility or unwillingness to perform master's qualification thesis or difficulties, etc., the applicant must notify the head or head of the Department of Power Plants and Systems in advance;

- arrive in time for the defense of the master's qualification thesis or notify the Head of the Department of PPS and the Head of the EC (through the Secretary of the EC) of the impossibility of attending the defense, indicating the reasons, followed by the provision of documents certifying the validity of the reasons.

In the absence of such documents, the EC may decide to decline the applicant's certification as having failed to appear for the defense of the master's qualification thesis without valid reasons, with subsequent expulsion from the university. If the applicant could not warn in advance of the impossibility of his/her presence at the defense, but during the period of the EC's work provided the necessary documents, the EC may postpone the date of the defense.

Rights of the applicant [1]:

- choose the topic of the master's qualification thesis from among those proposed by the Department of Power Plants and Systems or propose their own topic with the necessary justification for the feasibility of its development and the possibility of implementation;

- apply in writing to the Head of the Department of ESS (Appendix D) and initiate the issue of changing the topic, supervisor and consultants;

- get a separate workplace to perform the tasks of the master's qualification thesis in a special laboratory and have access to computer equipment, necessary visual aids, reference literature and standards, samples of fragments of qualification work and graphic material, methodological recommendations for the implementation and design of the work, etc;

- use the laboratory and information base of the Department of ESS and FEEEM, instruments, measuring equipment, etc. to conduct experimental tests, mathematical modeling or scientific research on the topic of research;

- receive advice from the supervisor and consultants;

- independently choose options for solving tasks for the master's qualification thesis;

- preliminary (at the department), initial or repeated (in the EC) defense of the master's qualification thesis;

- to address (orally or in writing) the Head of the EC, the management of the institute/faculty, the university and the Ministry of Education and Science with complaints or appeals regarding violations of their rights.

The MQT consultant is obliged to [1]:

- schedule consultations, indicating the time and place of their holding and informing the applicants;
- to set tasks for the applicant within his/her competence, achieving a clear understanding of the ways to solve them;
- recommend methods of resolving issues, leaving the applicant the right to make the final decision;
- to agree with the supervisor on the topic of the section and inform the supervisor about the status of this section, the persistence and independence of the applicant's research work on the section, his/her attitude to the implementation of the recommendations and the consideration of the consultant's comments;
- check the section in a timely manner and, if there are no comments, sign the individual task (see Appendix B).

The MQT opponent is obliged to [1]:

- on the basis of distribution by official note or by referral of the Head of the PPS Department (Appendix G) to receive from the student a master's qualification thesis for review;
- familiarize yourself in detail with the content of the master's qualification work and graphic (illustrative) material, pay attention to the scientific and technical level of development, modernity, validity and rationality of decisions, correctness of calculations, use of the latest technologies, compliance with the requirements of higher education standards, etc. If necessary, invite the applicant for an interview to obtain his/her explanations on the issues of his/her master's qualification thesis;
- within no more than two days, prepare a written response of the opponent to the master's qualification thesis.

3 MAIN REQUIREMENTS FOR MASTER'S THESIS AND ITS TOPICS

A master's qualification thesis can be completed in the form of a research work. Qualification thesis, the implementation of which requires a large amount of calculation and design research, can be performed as complex [1]. Complex thesis can be departmental, interdepartmental, interfaculty, and interuniversity.

Master's qualification thesis can be performed by order of an external enterprise or a relevant unit of VNTU. In the case of a master's qualification thesis to order, its individual and/or technical specifications are agreed with the customer, which is certified by the signature of the head or head of the structural unit and the seal of the customer's enterprise (institution).

The subject matter and content of master's qualification thesis must correspond to the educational and professional program "Power Plants" of the master's degree program in specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics" of the field of knowledge "Electrical Engineering".

An approximate list of topics for master's qualification thesis is formed, approved and communicated to students by the Department of Power Plants and Systems. The topics of master's qualification thesis are adjusted annually taking into account the experience gained at the department, the wishes of employers and specialists involved in the review of theses, and the recommendations of the examination commission.

The student chooses the topic of the master's qualification thesis independently. The student also has the right to propose his or her own topic of master's qualification thesis with proper justification of the feasibility of its development and the possibility of its implementation, which must be agreed with the supervisor and the head of the department.

The title of the topic should be concise and correspond to the content of the thesis. Duplication of research topics is not allowed.

Finally, the topic of the master's qualification thesis and the scientific supervisor are approved at a meeting of the Department of Power Plants and Systems on the basis of a written application submitted by the student to the head of the department, in which he or she may also express his or her wish to appoint a scientific supervisor. The assignment of the topic of the master's qualification thesis to the student and the appointment of the supervisor are formalized by an order of the VNTU, after which the clarification or change of the topic of the master's qualification thesis is allowed only in exceptional cases with the permission of the supervisor.

The content of the master's qualification thesis is determined by its topic and is reflected in the plan developed by the higher education student with the participation of the supervisor. According to the chosen topic, the higher education applicant, independently or on the recommendation of the supervisor, must familiarize himself/herself with the relevant regulations, scientific and educational

literature and draw up a draft plan, which he/she discusses and agrees with the supervisor [1].

The content of the MQT may include the results of theoretical and experimental research, development of new methods and methodological approaches. The MQT must meet the following requirements:

- be based on specific materials collected during scientific and practical research conducted during the course of study and during internships that the student undergoes during the period of study at the university;
- contain real proposals developed by the student that the Examination Commission (EC) could recommend for implementation;
- on the topic of the MQT, it is advisable for the student to have a publication and a presentation at a scientific and practical conference.

Recommended topics for qualification thesis for students studying for a master's degree in the educational program "Power Stations" are listed below:

1. Design of the electrical part of a nuclear power plant with the research of switching equipment.
2. Development of a fragment of an automated workplace for controlling the technological process of a thermal power plant.
3. Electrical part of a 3200 MW (4×800) condensing power plant with analysis of protection of switchgear.
4. Features of operation of relay protection of 110 kV power lines.
5. The electrical part of a 35.2 MW hydropower plant with a study of operating current grids.
6. Designing of photovoltaic power plants for power supply of sheltered houses using PV Sol Premium software.
7. Improvement of diagnostic methods for 750 kV shunt reactors.
8. The electrical part of a 120 MW hydroelectric power plant with aggregates of the SV-546/90-32 type with the study of the features of operation of high-voltage breakers.
9. Design of the electrical part of a nuclear power plant with the research of methods and means of hydrogen production.
10. The electrical part of a 90 MW hydroelectric power plant with units of the VGS-525/99-28 type with the calculation of relay protection of the hydrogen generator.
11. Research of methods and means of protection against double earth faults of overhead power lines. Improvement of diagnostic methods for 330 kV measuring current transformers.
12. The electrical part of a 60 MW hydroelectric power plant with units of the VGS 525/84-40 type with a study of the design features of ground fault protection devices.
13. Risks in determining the technical condition of high-voltage circuit breakers.
14. The electrical part of a 1900 MW condensing power plant with a research of insulation test methods.

15. Project of a wind power plant with a capacity of 0.5 MW.
16. Electrical part of a 2400 MW condensing power plant with a research of generator stability.
17. The electrical part of a 15 MW thermal power plant (6×P-2.5/35-5) with an analysis of the design features and operating conditions of surge arresters.
18. Optimization of the design of inputs taking into account typical damages.
19. The electrical part of a 300 MW hydroelectric power plant with an analysis of the load capacity of power transformers.
20. Refinement of the forecast of generation of photovoltaic power plants for the day ahead.
21. Electrical part of a 200 MW condensing power plant with analysis of open switchgear schemes.
22. Renewable energy sources in the balance of the integrated power system of Ukraine.
23. Features of microprocessor protection and automation of digital switchgear of power plants.
24. Electrical part of a 1280 MW condensing power plant with analysis of switching equipment.
25. The electrical part of a 19.2 MW hydroelectric power plant with aggregates of the VGS-440/39-40 type with the study of methods of preventive tests of electrical equipment insulation.
26. The electrical part of a 64 MW hydroelectric power plant with the study of automation systems.
27. The electrical part of a 198 MW thermal power plant (4×T-12-35+2×PT-60/75-130/13) with an analysis of the reliability of its facilities.

4 STRUCTURE OF MASTER'S QUALIFICATION THESIS

In the process of writing a master's thesis, the student must adhere to the oriented structure of the thesis, the order of placement of sections of the thesis and their volume established by the Department of Power Plants and Systems.

The content of the master's thesis is determined by its topic and is reflected in the plan developed by the student with the participation of the supervisor. In accordance with the chosen topic, the higher education applicant, independently or on the recommendation of the supervisor, must familiarize himself/herself with the relevant regulatory documents, scientific and educational literature and draw up a draft plan, which he/she discusses and agrees with the supervisor.

The approximate order of placement of the required sections of the textual content of the master's qualification thesis and their volume (in pages) is given in Table 4.1.

Table 4.1 –Approximate structure and approximate volume of the explanatory report of the master's qualification thesis

Numbering of the section	Title of section	Number of pages	Page numbering
–	Title page (Appendix A)	1	Not numbered
–	Individual task for the MQR (Appendix B)	2-3	Not numbered
–	Abstract in English and Ukrainian languages (Appendix C.1 and Appendix C.2 respectively)	1	Not numbered
–	CONTENTS (Annex D)	1–3	2
–	LIST OF ABBREVIATIONS (if necessary)	1	fact
–	INTRODUCTION	2–3	fact
1	SECTION 1 Analytical section	approximately 15-20% of the manuscript text	fact
2	SECTION 2 Research section	approximately 30-35% of the manuscript text	fact

continuation of Table 4.1

3	SECTION 3 Constructive or technological part	approximately 20-25% of the manuscript text	fact
4	SECTION 4 Relay protection	7–10	fact
5	SECTION 5 Labor protection and safety in emergency situations	10–12	fact
–	CONCLUSIONS	1–3	fact
–	LIST OF REFERENCES	not limited	fact
–	References	not limited	fact
–	Appendix A. "Illustrative part"	1	fact
–	Annexes B, C, D, etc.	not limited	fact

The recommended volume of the main text of the master's thesis is **70 - 100 pages** (1.5 line intervals, Times New Roman font, size 14) by the decision of the FEEEM Methodology Committee.

When calculating the volume of the main text of the master's qualification thesis, the following are not taken into account: individual task, abstract, content, additional sections (labor protection and/or safety in emergency situations), list of references, appendices [1].

After the appendices, the master's qualification thesis is accompanied by a graphic part and illustrative material that the student will present at the defense. The graphic and/or illustrative part of the MQT should contain 5-8 sheets of A1 format. A sample of the design of illustrative and graphic material for the defense of the master's qualification thesis is contained in the appendices.

The structure of the MQT can be adjusted depending on the specifics of the MQT at the direction of the supervisor.

Feedback from the supervisor and reviewer on the MQT is added to the thesis separately.

To defend the master's qualification thesis, higher education applicants are recommended to test the results of their research at a thematic conference. If desired, the applicant may publish an article based on the research materials in a domestic or foreign print or electronic publication. In this case, information about the approbation and publication of the results of the master's qualification

thesis should be indicated in the Introduction with a reference to the bibliographic note in the List of References.

The supervisor's review is made in any form and should indicate

- the relevance of the topic, in the interests or by order of which organization it was performed (within the framework of the research thesis of the department, enterprise, research institute, etc)

- compliance of the completed master's qualification thesis with the assignment;

- the level of disclosure of certain issues of the master's qualification thesis and the degree of independence in the performance of the work;

- level of theoretical and practical training, knowledge of professional literature, student's readiness to make modern decisions;

- the ability to analyze the necessary literary sources, make informed decisions, apply modern system and information technologies, conduct research with elements of modeling;

- the most important theoretical and practical results of the master's qualification thesis, their approbation (participation in conferences, seminars, patents, publications in scientific journals, etc;)

- compliance of the quality of student's training with the requirements of higher education standards and the possibility of awarding the appropriate qualification;

- other issues that characterize the student's professional qualities;

- position of the supervisor, his/her signature and date [1].

Opponent's review.

The opposition of the master's qualification thesis is carried out in order to provide the examination committee with an independent expert assessment of the professional competencies of applicants demonstrated in the preparation of the master's qualification thesis. It is conducted by practitioners and specialists in the fields of knowledge to which the topics of master's qualification thesis are devoted.

The opponent's feedback can be internal and external.

Internal opponents can be: experienced lecturers of other graduate departments of VNTU, who train specialists in related specialties or fields of knowledge.

External opponents can be: heads of relevant structural units of the practice base or organization where the applicant has practiced or works (for part-time study); researchers of research institutions; employees of enterprises and organizations of various forms of ownership in the field of specialization, as well as specialists in the field of qualification thesis.

The opponent's review is made in any form, including

- compliance of the master's qualification thesis with the approved topic and task;

- relevance of the topic;

- Reality of the master's qualification thesis (its implementation by order of enterprises, organizations, on the scientific topics of the department, research institute, etc;)
- correctness of the feasibility study for decision-making;
- the degree of use of modern achievements of science, technology, production, information and engineering technologies;
- validity and originality of the decisions made and the results obtained;
- correctness of the calculations and design and technological solutions;
- availability and completeness of experimental (physical or mathematical) confirmation of the decisions made;
- quality of execution and compliance of textual and graphic or illustrative material with the requirements of current standards;
- the possibility of implementing the results of qualification thesis;
- shortcomings of the thesis;
- grades according to the university grading scale ("A", "B", "C", "D", "E", "FX" - the opponent's grade must be substantiated) and the possibility of awarding the applicant an educational qualification;
- the opponent's position, signature and date.

The opponent's review must not duplicate the supervisor's review, because the supervisor's review is mainly a characterization of the student's professional and personal qualities and his/her work in the process of performing qualification thesis (studying at VNTU), and the opponent's review is a characterization of the quality of the master's qualification thesis itself. Cases of their complete coincidence indicate a formal approach to opposition and should be timely detected by the head of the graduating department, who should take measures to prevent this.

If the opponent is an employee of an external organization (another university, research institute, enterprise, institution, etc.), the seal of that organization is affixed to the review, which certifies his or her signature.

Negative review of the supervisor or opponent is not a ground for preventing a student from defending a master's thesis.

5 RECOMMENDATIONS FOR WRITING INDIVIDUAL STRUCTURAL ELEMENTS OF MASTER'S THESIS

TITLE PAGE (included in the total number of pages, but the page number is not given). On the title page, the applicant indicates the topic of the master's qualification thesis, his/her surname, name, as well as the surname, initials, academic degree, academic rank and position of the supervisor and reviewer. The applicant who has completed the master's qualifying thesis and the supervisor sign the title page. The opponent's signature must be on the title page (Appendix A) [1].

INDIVIDUAL TASK (not numbered, not included in the total number of pages). The individual assignment is signed by the supervisor, consultants and the applicant, and is signed by the Head of the PPS Department (Appendix B). When completing the master's qualification thesis, the completed individual task is placed after the title page.

The abstract is placed after the individual task before the contents on a new page. The abstract is submitted in English (Appendix B. 1) and English (Appendix B. 2) on separate sheets. The abstract is intended for express introduction to the master's qualification thesis. It should be concise and sufficiently informative.

THE ABSTRACT must contain information about the volume of the master's qualification thesis, the number of sections in its structure, as well as illustrations, tables, appendices, sources according to the list of references (all information is provided, including data from the appendices). The text of the abstract should represent the information presented in the master's thesis and the results obtained. The presentation of the material in the abstract should be concise and accurate. It is necessary to use the syntactic structures of the scientific language, to avoid complex grammatical phrases.

At the end of the text of the abstract, the keywords of the MQT are indicated. The list of 5-10 keywords (phrases) is printed nominative case in a line. [1].

THE CONTENTS (Appendix D) of the master's thesis is submitted after the abstract. The Contents includes: sequentially listed names of all structural elements of the qualification thesis with the page numbers from which they begin. The headings of the Table of Contents must correspond exactly to the headings in the text of the qualification thesis. They may not be abbreviated or presented in a different wording, sequence, or subordination compared to the headings in the text. Headings of the same degree of rubrication must be placed one below the other [1].

The first page of contents with the heading " CONTENTS" in the center of the page is placed after the abstract, starting on a new page. The table of contents includes: introduction; sequentially listed titles of all sections, subsections; conclusions; list of references; titles of appendices and page numbers that contain the beginning of the material.

The contents does not include the title page, the individual task for the MQT,

and annotations.

The numbering in the contents starts with the introduction (according to the numbering in the explanatory note). The titles of the headings of the table of contents should unambiguously correspond to the titles of the explanatory note on the text.

LIST OF ABBREVIATIONS (if any). If the master's thesis uses little-known abbreviations, new symbols, designations, etc., their list may be presented in a separate list that is placed before the introduction. The list of abbreviations should be printed in two columns, with the abbreviations listed alphabetically on the left and their detailed interpretation on the right. If special terms, abbreviations, symbols, designations, etc. are repeated less than three times in the qualification paper, the list is not compiled, and their interpretation is given in the text at the first mention. It is not recommended to use non-generally accepted and little-known abbreviations in the titles of sections and subsections.

INTRODUCTION reveals the essence and state of the task (experimental, design, technological development, etc.), its significance, the grounds and initial data for the development of the topic, and the justification of its relevance. The Introduction should provide a general description of the work in the sequence recommended below. The length of the introduction should not exceed 2-3 pages.

Relevance of the topic (minimum 4-6 sentences). By means of critical analysis and comparison with the current state of the art, the relevance and feasibility of the master's qualification thesis for the development of the relevant field of science or industry is substantiated, especially focusing on its relevance to Ukraine.

Connection of the thesis with scientific programs, plans, topics. This subparagraph is not necessary. If necessary, it contains information about the connection of the master's qualification thesis with scientific programs, plans, topics, in particular, departmental research work, basic and applied research and/or research (experimental) developments that are being carried out (or were carried out) at the expense of the general fund of the state budget or at the expense of concluded economic contractual agreements, various types of grants, etc.

Goal and tasks of the thesis. Formulate the goal of the master's qualification thesis and the tasks that need to be solved to achieve it. It is not necessary to formulate the goal as "Research...", "Study...", because these words indicate the means of achievement, not the goal itself. The goal of the master's qualification thesis is usually closely related to the title of the MQT and should clearly indicate what exactly is being addressed in the thesis. The goal and objectives of the MQT are formed on the basis of the analysis of literature sources and determination of the relevance of the topic. The goal is revealed by the list of tasks to be solved in the master's qualification thesis.

The object of research is a process (or phenomenon) that generates a problematic situation selected for research. The object of research is a certain system, equipment, device, process, technology, software product, information technol-

ogy, intellectual product, economic activity, etc. that generates a problem situation and is selected for research.

The subject of research is certain properties, characteristics of the object that the research itself is directly aimed at, since the subject of research determines the topic of the qualification thesis, which is indicated on the title page. Thus, the object and subject of the study are related to each other as general and specific.

Novelty of the results obtained. Provide a brief summary of new results or innovative solutions obtained by the applicant personally. It is necessary to show the difference between the results obtained and those known earlier. The theoretical, methodological and practical significance of the results obtained, as well as the innovativeness of the proposed approaches, are noted.

Personal contribution of the applicant. The master's qualification thesis is an independently performed work in which the author has developed... (formulate briefly based on the purpose of the study).

The concepts, conclusions and recommendations submitted for defense were obtained by the author independently. From the research publications published in co-authorship, the master's thesis uses only those provisions that were developed by the author personally.

Publications of the results of the master's qualification thesis (if any). The number and list of publications (printed or electronic resources) in the form of patents, certificates of authorship, articles in scientific journals, collections of scientific articles, materials and abstracts of conferences, in which the results of the master's qualification thesis are published, are indicated. It is allowed to indicate as publications the preprints of manuscripts of scientific articles submitted for publication, with the obligatory indication of the access URL in the list of references.

The main part of the thesis is its main structural component, which includes the presentation of information about the subject and object of research or development that is necessary and sufficient to reveal the content of the thesis and its results. It consists of sections, subsections, paragraphs, subparagraphs.

SECTION 1 – analytical, containing a review of literature and an analysis of the current state of theory and practice on the topic of the master's qualification thesis (2 - 4 subsections of the qualification thesis). In it, the applicant demonstrates his/her analytical and research competencies, reveals the current state of theory and practice on the topic of the master's qualification thesis, analyzes various theories and concepts, conducts a critical review of relevant scientific sources, expresses and justifies the author's position, and formulates problematic issues.

SECTION 2– theoretical research (2 - 4 subsections of the master's qualification thesis). In this section, the applicant conducts theoretical research and analytical calculations. All analytical calculations, tables, figures must be accompanied by interpretations and conclusions that allow to determine the content of the studied processes, their features, trends, and vectors of change. The problem

should be analyzed taking into account the factors of positive and negative influence. The correct generalization of the accumulated factual material, grouping and processing of data, on the basis of which a qualified analysis is carried out, and proposals are substantiated, is of great importance.

In preparing this section, it is recommended to use mathematical methods, software tools for grouping, calculations and analysis. The applicant, the author of the qualification thesis, is responsible for the results of the calculations and the conclusions made on their basis.

SECTION 3 –constructive (2 - 4 subsections of the master's qualification thesis). The development of this section involves the demonstration of the applicant's creative and combinatorial abilities and creative research skills. The constructive section should contain reasonable proposals of the applicant aimed at achieving the purpose of the study. The proposed measures should be based on the results of the analytical and theoretical sections of the master's qualification work.

If necessary (if it is required by the topic, object, subject, purpose and objectives of the research), an experimental verification of the statements made in the master's qualification work is carried out. This section presents the results of experimental, simulation or modeling studies that allow verifying the correctness of the theoretical calculations made in the work. The description of the results obtained is preceded by a description of the developed experimental layout, installation, equipment, software, computer mathematical or applied modeling.

SECTION 4 – "Relay protection" (if necessary) of no more than 10-12 pages. In this section, the calculation of the relay protection settings for the object under study is performed. The main types of protection are described, the method of calculating the settings of each type of protection is described.

SECTION 5 – " Labor Protection and Safety in Emergency Situations" of no more than 7-10 pages. In this section, using regulatory documents, an analysis of dangerous and potentially harmful production factors in the production premises is carried out; a list of potentially dangerous and harmful factors is described and classified, possible causes of these factors are identified and a brief description of their effect on the employee's health is given; a list of working conditions is filled in; measures to improve working conditions are indicated, calculation and selection of methods of protection against the dominant harmful or dangerous factor of the production environment is carried out and/or the following is given

A specific task for the implementation of this section is issued by the consultant on labor protection. The task must be agreed with the head of the MQT.

CONCLUSIONS are the final part of a master's thesis. They are placed after the main part, starting on a new page.

The conclusions contain a summary (thesis) of the main results of the research on the chosen topic, obtained during the analysis of the estimates and generalizations, the author's practical recommendations for solving the tasks given in the Introduction and the feasibility of their further use. It is necessary to

emphasize the new solutions found to certain elements of the research and the introduction of advanced technologies.

The overall economic effect of the analysis is also assessed, the negative and positive aspects of the practice are described, and the necessity and feasibility of the measures proposed by the author, aimed primarily at improving the functioning of the object under study, are substantiated.

THE LIST OF REFERENCES should be placed in the order in which the references appear in the text (the most convenient for use and recommended for writing qualification thesis).

Bibliographic descriptions are given in accordance with the standard NSU 8302: 2015 "Information and documentation. Bibliographic reference. General Provisions and Rules of Compilation" [3] or other international bibliographic styles (IEEE style, MLA style, APA style, Harvard style, Chicago style, etc.)

The recommended size of the list of references for a master's qualification thesis is 20-40 items.

THE APPENDICES contain the material that is necessary for the completeness of the thesis, but its inclusion in the main part of the thesis may change the orderly and logical presentation of the thesis, as well as the material that cannot be consistently placed in the main part of the thesis due to its large volume or methods of reproduction [1].

Each appendix must have a thematic (substantive) title, which is written in the middle of the line in lowercase letters, starting with a capital letter. If there is a main inscription, the title is written in the appropriate column.

All appendices are included in the table of contents, indicating the number, title and pages from which they begin.

GRAPHIC PART. The material of the graphic part of master's qualification thesis is drawn up on graphic sheets in the form of drawings, diagrams and/or posters in compliance with the standards of the Unified System of Design Documentation [5]. It is necessary to make references to the graphic part of the research in the explanatory note.

Each drawing must have the signatures of the applicant, supervisor, standard controller, head of the department, and opponent.

If the graphic information of the MQT is submitted in the form of drawings and/or diagrams, they should be properly executed, that is, the back of the sheet should contain

- frame;
- main inscription (55 mm × 185 mm);
- mandatory signatures (of the applicant, supervisor, and standard controller).

If one whole sheet of A1 format contains information on smaller formats (for example, A2 or A3), then the A1 format should be properly divided into smaller standard formats.

6 REQUIREMENTS FOR THE DESIGN OF THE TEXT PART OF MASTER'S QUALIFICATION THESIS

6.1 General requirements

The master's thesis is prepared in accordance with the state standards of Ukraine [1, 3, 4]:

- NSU 3008:2015 "Information and documentation. Reports in the field of science and technology. Structure and rules of execution";
- NSU 8302: 2015 "Information and Documentation. Bibliographic references. General provisions and rules of preparation".

An explanatory note refers to text documents that contain information presented mainly in technical language and graphic information in the form of illustrations, which may be fragments of diagrams, graphics, photographs, etc. Some information may be presented in the form of formulas. Digital information is more often presented in the form of tables.

The textual part is drawn up on one side of A4 white paper (210x297 mm) using computer equipment. The font should be simple, straight, of the same type (without highlighting and underlining) and at least 2.5 mm in size (Times New Roman, size 14). The page should have at least 30 and no more than 40 lines.

The recommended volume of the main part of the master's thesis (from the title page to the list of references inclusive) is 70-100 pages (1.5 line spacing, Times New Roman font, size 14). When calculating the volume of the main text of the master's qualification thesis, the individual task, abstract, appendices and illustrative material are not taken into account.

THE USE OF PHOTOCOPIES (SCANNING) IS STRICTLY NOT ALLOWED! Only clear edited copies are allowed in the review part of the paper.

The text of the master's thesis must be printed, leaving the following sizes of borders: left - 25 (30) mm, right - 15 (10) mm, top - 20 mm, bottom - 20 mm. The print font should be clear, the ribbon should be black in medium bold. The density of the text of the master's qualification thesis (project) must be the same.

The structural elements of the text part are sections, subsections, paragraphs, and subparagraphs.

A section is the main level of text division, indicated by a number (1, 2, ... etc.) and has a title.

Subsection - a part of a section, indicated by a number (1.1, 1.2, ..., etc.) and a title.

Paragraph is a part of a subsection, indicated by a number (1.1.1, 1.1.2, ... 3.1.2, etc.) and may have a title.

Subparagraph is a part of a paragraph, indicated by a number (1.1.1.1, 1.1.1.2, ... 2.3.2.1, etc.) and may have a title. The number is not punctuated by a period, but by a single symbol.

The headings of the structural parts of the master's qualification work "CONTENTS", "LIST OF ABBREVIATIONS", "INTRODUCTION", "SECTION", "CONCLUSIONS", "REFERENCES", "APPENDICES" are printed in large letters symmetrically to the text. Do not put a point at the end of the title. If the title consists of two sentences, they are separated by a point.

It is recommended to start each section of the text part with a new page. Sections are numbered with Arabic numerals throughout the text. No numbers are assigned to the Introduction, Conclusions, and References.

Subsection titles, except for the first one, are written in lowercase letters and are spaced in a paragraph. Subsections are numbered within each section, paragraphs - within each subsection, and subparagraphs - within each paragraph.

The following rules should be followed when writing a thesis:

a) the text must be presented in a reasonable manner in a concise technical style;

b) conditional letter designations of physical quantities and conditional graphical designations of components must comply with the established standards. The letter designation of a physical quantity should be preceded by its explanation (resistor R, capacitor C);

c) numbers with dimension should be written in numbers, and without dimension - in words (distance - 2 mm, measure three times);

d) the designation of units should be written in the line with the numerical value without transferring to the next line. A space should be left between the last digit of the number and the unit designation (100 W, 2 A);

e) if a series of numerical values of the same physical quantity is given, the unit of the physical quantity is indicated only after the last numerical value (7.5; 1.75; 2 mm);

f) the marking of values with maximum deviations should be written as follows: 100 ± 5 mm;

g) letter symbols of units included in the product are separated by a point on the middle line (\cdot); the division sign is replaced by a slash (/);

i) ordinal numerals should be written in numbers with case endings (9th day, 4th line); in the case of several ordinal numerals, the case ending is written after the last one (3rd, 4th, 5th graphs); quantitative numerals are written without case endings (on 20 sheets); do not write the ending in dates (October 21) and in Roman numerals (XXI century);

k) abbreviations of words in the text are not allowed, except for those generally accepted in the Ukrainian language and established regulatory documents, as well as abbreviations that are accepted for inscriptions on the product (in the text they must be highlighted in capital letters: ON, OFF), and if the inscription consists of numbers or signs, then in quotation marks. The names of commands, modes, and signals ("Start") are also set off with quotation marks;

l) it is allowed to record mathematical expressions by form:

$$\frac{ABC}{DE} = ABC/DE;$$

replace the multiplication sign "×" with an asterisk "*" (NS 2.004-88).

In the text of the explanatory note it is not allowed to

- use different scientific terms that are close in meaning (synonyms) for the same concept, as well as foreign words and terms, if there are equivalent words and terms in the Ukrainian language;
- use abbreviations of words other than those established by the rules of Ukrainian spelling and relevant standards;
- abbreviate the designation of physical quantities if they are used without numbers, except for physical quantities given in tables;
- use mathematical signs without numbers, for example, >, <, = (greater than, less than, equal to), as well as the signs № (number) та % (percent).

6.2 Formatting formulas

Formulas and equations are positioned on a new line directly after the text in which they are written, symmetrically to it. A single line is left between the formula and the text. This applies to the largest, as well as long and cumbersome formulas that have signs for sum, product, differentiation, integration, and all numbered formulas. Small and simple formulas that do not have independent meaning are entered in the middle of the lines of the text [1].

All formulas are numbered within the same section with Arabic numerals. The number is indicated in round brackets on the right side, at the end of the line, at the end of the formula; it consists of the section number and the ordinal number of the formula, separated by a period, for example, (1.3) - the third formula of the first section (except for the formulas given in the appendices). The number of the fractional formula is given at the level of the main horizontal line of the formula.

The unit of measurement, if necessary, is taken in square brackets. Numerical substitution and calculation are performed from a new line without numbering. The unit of measurement can be taken in round brackets.

Explanations of the meanings of symbols and numerical coefficients included in a formula should be given in the text or directly below the formula. To do this, place a comma after the formula and write the explanation for each symbol on a new line in the sequence in which they appear in the formula, separated by semicolons. Start the first line of the explanation with the word "where" without a colon.

For example:

$$I = \frac{U}{R} [A], \quad \text{or} \quad I = U / R [A], \quad (2.1)$$

where U — power supply voltage;

R — active resistance of an electrical circuit.

$$I = \frac{220}{100} = 2,2 \text{ A}, \quad \text{or} \quad I = 220/100 = 2,2 \text{ (A)}.$$

Large formulas can be transferred to subsequent lines. You can only use the mathematical signs (=, +, , :) to continue the formula, repeating the sign at the beginning of the next line.

Formulas are sentence elements; therefore, punctuation marks must be used at the end of formulas and in the text before them in accordance with the rules of punctuation. A colon is placed before a formula in cases stipulated by the rules of punctuation: in the text, there is a generalizing word before the formula; this is required by the structure of the text preceding the formula.

A comma or semicolon immediately following a formula and not separated by text may be used as a punctuation mark between formulas that follow each other and are not separated by text.

References to formulas in the text are given in parentheses according to the form: "... in formula (3.2)"; "... in formulas (3.2, ... , 3.10)".

6.3 Design of figures and tables

Figures (photographs, drawings, diagrams, graphs, maps) and tables must be presented in the master's thesis directly after the text where they are first mentioned or on the next page. Figures and tables that are placed on separate pages of the qualifying thesis are included in the general page numbering. A table, figure, or drawing that is larger than A4 is considered one page and is placed in the appropriate places after the mention in the text or in the appendices.

Figures are referred to as "Figure" and not "Fig." and are numbered consecutively within the section, except for the illustrations in the appendices.

Print the title at the BOTTOM of the figure.

Position figures in the text or in appendices.

In the text, the figures are positioned symmetrically to the text after the reference to them, which is made in the form: "... shown in Figure 3.1" or in parentheses in the text (Figure 3.1). One line (3 intervals) should be left between the figure and the text; no period should be placed at the end of the title [1].

Number illustrations within sections by specifying the section number and the line number of the figure in the section, separated by a period.

You may number illustrations throughout the document.

Explanatory data should be placed below the figure above its title.

In case the figure consists of parts or more, they are indicated by lowercase letters of the Ukrainian alphabet with a bracket (a, b, ...) under the corresponding part.

In this case, a colon is placed after the title of the figure and each part is named according to its form:

a) - the title of the first part; b) - the title of the second part
 or in the text of the title of the figure, putting the letters in brackets:
*Figure 3.2 - Electrical grid scheme (a) and three-phase short circuit current
 scheme (b)*

If parts of the figure do not fit on one page, they are transferred to the following pages. In this case, the full designation of the figure is indicated at the beginning of the figure, and its continuation is indicated as "Figure 3.2 (*continue*)". Explanatory data is placed under each part of the figure.

It is recommended to place digital and other data in the text part in tables.

Each table should have a title that is placed above the table and printed symmetrically to the text. The title and the word "Table" begin with a large letter. The title is not underlined.

An example of a table design is given below (Table 2.1).

Table 2.1—Results of calculations of short-circuit currents

All tables should be referenced in the form: "given in Table 2.1"; "... in Tables 2.1 - 2.5" or in parentheses in the text (Table 2.6). A reference to the previously cited table is given with the abbreviated word "see" (see Table 2.1) in the text or at the end of the sentence [1].

The table is divided into columns and rows. The header of the table is placed at the top, where the names of the columns are indicated. Diagonal division of the table header is not allowed. The left column (sidebar) is often used to name rows. Rows may not be divided by horizontal lines. The minimum size between row bases is 8 mm. The size of the table is determined by the volume of the material.

If numbering is necessary, the numbers are indicated in the sidebar of the table before the line name.

The name of the column may consist of titles and sub-titles, which are written in the singular, symmetrically to the text of the column in lowercase letters, starting with a large letter. If the subheading is the same sentence as the title, then it is written in small letters, starting with a large letter. Do not put a full stop at the end of titles and sub-titles of table columns. It is allowed to single-space the titles and sub-titles of a table graph.

If all the parameters of the quantities given in the table have the same unit of physical quantity, then its abbreviation (mm) is placed above the table. If the parameters have different units of physical quantities, then the unit designations are written in the graph titles after the comma (Length, mm).

The text of graph titles and subheadings can be replaced by letter symbols, if

only they are explained in the previous text or figures (D - diameter, H - height, etc.). The same letter designations are used sequentially in ascending order of their indices, for example: (L1, L2, ...).

Row names are written in the side of the table in the form of titles in the nominative singular, in small letters, starting with a large one and in the same position. Do not put a full stop at the end of the titles. The designation of units of physical quantities is indicated in the titles after the comma.

To describe a certain interval of values in the names of columns and rows of the table, you can use the words: "more than", "less than", "not more than", "not less than", "within". These words are positioned after the unit of physical quantity:

(Voltage, V, no more),

and also use the words "from", "more than", "to":

(from 10 to 15; more than 15; up to 20)

Data in a table can be verbal or numeric.

Words are written in columns from one position. If the rows of the table are not separated by lines, then repeated text consisting of one word may be replaced with quotation marks ("). If the text consists of one or more words, the first time it is repeated, it is replaced with the words "the same" and then with quotation marks. If the table is divided by horizontal lines, no substitution is made.

Numbers are written in the middle of the column so that their identical digits throughout the column are exactly one below the other, except when an interval is specified. The interval is indicated from the smaller number to the larger one with a dash between them:

$12 - 35$

$122 - 450$

Fractional numbers are written as decimals, with the same number of signs after the decimal point in one column. Dimensions in inches can be written in the form: $1/2$ ", $1/4$ ", $1/8$ ".

You cannot use quotation marks to replace numbers or repeated mathematical symbols. If no numbers or other data are given in the table, a dash is placed.

Tables are numbered within the sections and marked on the left above the table according to the form: "Table 4.2 - Table name". No period is placed at the end. If the name of the table is long, it is continued on the next line starting from the word "Table". The table number consists of the section number and the ordinal number of the table in the section, separated by a period. It is allowed to be numbered throughout the document.

A table can be large both horizontally and vertically, or in other words, it can have a large number of columns and rows. In such cases, the table is divided into parts and moved to other pages, or one part is placed under another or next to another.

If parts of the table are placed side by side, the table title is repeated in each part, and if one part is placed under the other, the sidebar is repeated.

If a table is interrupted at the end of a page and continues on the next page, the lower horizontal line that borders the table is not drawn in the first part of the table.

When transferring parts of the table to other pages, repeat or extend the names of the columns. It is permitted to number the columns at the beginning of the table and, when moving parts of the table to subsequent pages, to repeat only the column numbering.

In all cases, the name (if any) of the table is placed only above the first part, and above the other parts on the left write "*Continue table 4.2*" without a period at the end.

Other requirements for the execution of tables are in accordance with applicable standards for technical documentation.

6.4 General rules for citing and referencing sources

The main part of the explanatory note is completed by the "List of References", which should be placed in the order of references in the text (the most convenient for use and recommended when writing master's theses).

Bibliographic descriptions are given in accordance with the standard NSU 8302:2015 "Information and Documentation. Bibliographic reference. General Provisions and Rules of Compilation" or other international bibliographic styles (IEEE style, MLA style, APA style, Harvard style, Chicago style, etc.). When using literary sources, publications of recent years based on current regulatory documents, current regulatory documents itself, publications in periodicals devoted to electricity issues, and materials from the Internet should be considered.

In the text of the note, references to the literature are placed in square brackets, for example, [15], where 15 is the number of the source in the list of references.

A sample of a list of references

1. Bondarenko E.A., Kutin V.M., Lezhnyuk P.D. Educational materials for the section "Labor protection" in master's qualification thesis for students of specialty 141 "Electric power engineering, electrical engineering and electromechanics": a course book. Vinnytsia: VNTU, 2018. 46 p.

2. Computer program "Software complex for calculating power and electricity losses in 110(35)-10(6)-0.4 kV distribution grids and developing measures to reduce them - Losses" ("Losses") / [P. D. Lezhniuk, V. V. Kulyk, K. I. Kravtsov, O. B. Burikin, V. O. Komar] // Certificate of registration of copyright in a work No. 34106. State Department of Intellectual Property of the Ministry of Education and Science of Ukraine, Department of Copyright and Related Rights. 2010.

3. Kulyk V. V., Pisklyarova A. V., Pisklyarov D. S. Methods and means of increasing the accuracy of determining electricity losses in 10(6) kV distribution grids using fuzzy sets: monograph. Vinnytsia: Universum-Vinnytsia, 2011.

146 p.

4. Lagutin V. M., Teptya V. V., Vyshnevskiy S. Y. Own needs of electric power stations: a course book. Vinnytsia: VNTU, 2008. 102 p.
5. Lezhnyuk PD, Lagutin VM, Teptya VV Design of the electrical part of power plants: a course book. Vinnytsia: VNTU, 2009. 194 p.
6. Distribution system development plan of Vinnytsiaoblenergo JSC for the period 2021-2025. URL:
7. <http://www.voe.com.ua/sites/default/files/VTS/Plan%2021-25/plan-rozvytku-vinnycyaoblenergo-period-2021-2025-rokiv.pdf> (accessed March 25, 2021).
8. Regulations on qualification thesis at the second (master's) level of higher education. SQS VNTU-03.02.02-P.001.01:21 / Compiled by A. Semenov, L. Gromova, O. Serdiuk, T. Makarova. Makarova. Vinnytsia: VNTU, 2021. 60 p.
9. Rules for the safe operation of consumer electrical installations: NPAP 40.1-1.21-98: Approved. 09.01.1998 № 4 / State Committee of Ukraine for Supervision of Labor Protection. Kyiv, 2008. 150 p.
10. Rules for the installation of electrical installations. Official publication. Ministry of Energy and Coal Industry of Ukraine. Kharkiv: Fort Publishing House, 2017. 760 p.
11. Solomchak O. V. Methodology for selecting and comparing options for compensating reactive power / Energetics and Electrification. 2004. №9. P.23-26.
12. PCM2704/PCM2705/PCM2706/PCM2707. Stereo audio DAC with USB interface, single – ended headphone output and S/PDIF output. Datasheet. Rev. 4; 5/2004. – Texas Instruments corp. – 34 p. URL: <http://focus.ti.com/lit/ds/symlink/pcm2706.pdf> (accessed: 15.02.2021).
13. Fernandes Camila, Frías Pablo , Reneses Javier Participation of intermittent renewable generators in balancing mechanisms: A closer look into the Spanish market design *Renewable Energy*. 2016, Vol. 89, P. 305-316.

7 REQUIREMENTS FOR THE DESIGN OF THE ILLUSTRATIVE PART OF MASTER'S QUALIFICATION THESIS

7.1 General requirements

The illustrative part is an integral part of the MQT. The content of the illustrative material should sufficiently reflect the main points to be defended.

The illustrative part of the MQT is made in MQT the form of posters and drawings (A4 or A1 format) and is provided in the form of a multimedia presentation made in MS PowerPoint (or other environment) and demonstrated to the representatives of the examination committee using a computer projector.

The total number of sheets of illustrative material is at least five. A list of posters for the illustrative part is recommended:

Poster 1 - relevance, purpose, and tasks to be solved to achieve the goal.

Poster 2 - object, subject of research, novelty, practical value (for papers of a scientific nature).

Poster 3 - characteristics of existing analogs, their advantages and disadvantages.

Poster 4 - description of the mathematical apparatus used in the MQT (if any).

Poster 5 (there may be several) - implementation of the proposed solutions (algorithms, structural diagrams, main electrical connection diagram, system operation diagrams, plans and cross-sections of distribution plant cells, etc.)

Poster 6 (there may be several) - results of experimental research.

Poster 7 - economic calculations (results).

Poster 8 - conclusions.

Poster 9 - testing of results and publications (if necessary).

The illustrative part is attached to the explanatory note of the Master's qualification thesis after the appendices. It starts with a blank sheet with the words "Illustrative part" and the topic of the Master's qualification thesis in capital letters in the middle (Appendix M).

The posters for the illustrative part of the Master's qualification thesis (MQT) can be designed in any way, but the general guidelines are as follows: white background, black text and black and white pictures. Each poster should have a title.

7.2 Graphic part

The graphic part is made with lines of appropriate thickness and shape.

For each assembly drawing of the work, specifications shall be drawn up and executed in accordance with the requirements. The form, dimensions, content and procedure for filling in the main inscription and additional columns to it are set out in the National Standard of Ukraine / State Standard of Ukraine

2.104:2006 [5].

The standard establishes three forms of the main inscription (Figure 7.1):

a) form 1 (55×185 mm) – for the first sheets of the schemes;

b) Form 2 (40×185 mm) – for the first pages of text documents;

c) form 2a (15×185 mm) – for the following sheets of diagrams and text documents.

Figure 7.1 - Basic labels and graphs for drawings and diagrams

Place the main caption at the bottom right of the workspace frame.

The procedure for filling in the main inscription columns (Figure 7.1, Appendix P):

- in column 1, indicate the name of the product or the name of the document, which is written in the nominative singular. The noun (Non-linear surge arrester) is written in the first place. Below that, write the name of the document in a smaller font (Electrical circuit diagram). The words are not hyphenated and no period is placed at the end of the names;

- in column 2, indicate the designation of the document in accordance with the instructions of VNTU;

- column 3 indicates the material of the part (this column is filled in only on the drawings of parts);

- in column 4, indicate the letter corresponding to the stage of development of the document, for example: draft design – E, technical design – T, study design – U;

- in column 5, indicate the weight of the product in kilograms without the unit of measurement kg (if the unit of measurement is different, then write);

column 6 indicates the scale:

a) natural size 1:1;

b) scale of reduction - 1:2, 1:2.5, 1:4, 1:5, 1:10;

c) scale of increase - 2:1, 2.5:1, 4:1, 5:1, 10:1;

- in column 7, indicate the serial number of the sheet (for documents consisting of only one sheet, the column is not filled in);
- column 8 indicates the total number of sheets in the document;
- in column 9 - the index of the enterprise (VNTU, group PS-22m);
- in column 10 - the nature of the work of the person signing the document (for the MQT – Developed, Head, Consultant, N. control, Opponent, Approved);
- in columns 11, 12 – names (without abbreviation) and signatures (with a black ink pen) of the persons signing the document;
- in column 13 - the date of signing the document;
- columns 14 ... 18 – for making changes in accordance with the interstate standard National Standard of Ukraine / State Standard of Ukraine 2.503 [5].

Additional columns (19-25) are placed on the left outside the working field.

In master's qualification works, these columns are not filled in.

Additional column 26 has dimensions of 70×14 mm. This column contains the designation of the document [5].

For A4 and larger formats placed horizontally, this box is rotated 180° and placed in the upper left corner of the frame. For formats larger than A4 and placed vertically, the box is rotated 90° counterclockwise and placed in the upper right corner of the frame.

Below are the basic rules for some types of diagrams that are most commonly presented in the graphical part.

7.3 Requirements for the design of electrical schematics

7.3.1 Types of diagrams

A block diagram shows the main functional parts of the product, their function and their interconnections.

A function diagram explains the individual processes that take place in the individual functional circuits or in the product as a whole. These diagrams are used when studying the principles of product operation, when setting up, monitoring and repairing products.

A circuit diagram defines the complete composition of elements and connections between them and, as a rule, provides a detailed understanding of the product's operating principles. The schematic diagram serves as a source document for the development of other design documents, including drawings.

A wiring diagram is used to develop design documents that define the laying and fastening methods of wires, harnesses and cables or pipelines in the product, as well as to make connections during the control, operation and repair of products.

Wiring diagrams are used to make external connections to the products during their operation.

The component parts of the complex, as well as their interconnection at the

place of operation, are determined by the general scheme.

The relative position of the components of the products and (if necessary) wires, harnesses, cables is shown in the layout diagram.

When two or more types of diagrams for the same product are required in one design document, a combined diagram is drawn up.

The type and type of diagram determine its name and code.

7.3.2 Electrical structure diagram

The electrical schematic diagram defines the main functional parts of the product (elements, devices, functional groups), their purpose and connections.

All functional parts in the diagram are represented by rectangles or symbols. When depicted by rectangles, the names, symbols or numbers of functional parts are entered in the middle of the rectangles. Symbols and numbers shall be deciphered in the free field of the diagram in a table of any form. Positional designations are written above or to the right of the symbols.

Rectangles or subassemblies in the diagram are connected by electrical communication lines, on which arrows indicate the direction of the work process. The block diagram should give an idea of the workflow in the direction from left to right, from top to bottom.

If there are a lot of functional parts, the latter are replaced by squares with sides in multiples of 12 mm. In this case, instead of names, types, and designations, serial numbers are placed to the right of the image or above it, usually from top to bottom in the left-to-right direction, and deciphered in a table of any form, which is placed on a free field of the diagram.

It is recommended to place explanatory labels, diagrams, tables, indications of parameters at characteristic points (currents, voltages, pulse shapes, and magnitudes), mathematical dependencies, etc. on the diagram.

7.3.3 Functional Electrical Diagram

The function diagram shows the processes that take place in the individual functional circuits of the product or in the product as a whole. Compared to the structural diagram, it shows the functions of individual elements or devices in more detail.

The diagram shows all functional parts of the product and the main connections between them.

Functional parts in the diagram are depicted in the form of symbols in accordance with applicable state standards. It is allowed to depict individual functional parts that do not have a block diagram in the form of rectangles, as well as to disclose them to the level of schematic diagrams.

It is allowed to combine functional parts into functional groups, which are highlighted on the diagram by dashed and dotted lines. Each selected group is assigned a name or symbol.

The diagram should indicate

- for each functional part represented by a rectangle, its name or symbol entered in the rectangle;
- for each functional part or element depicted by the GCP, the position designation.

If a functional diagram is used together with a schematic diagram, the position designation of elements and functional parts in these documents must be the same. In this case, the list of elements is not developed for the functional diagram, since the data from the schematic diagram is used. If a functional diagram is developed independently (without a standard diagram), the positional designation of elements and functional parts is indicated according to the general rules and a list of elements is developed.

It is recommended to indicate technical characteristics of functional parts, diagrams, signal parameters, etc. next to the graphical designation or in a free field of the diagram.

7.3.4 Electrical circuit diagram

The schematic diagram is the most complete diagram of the product and provides a detailed understanding of its operation.

The diagram shows all the components of the product and the connections between them, as well as the elements that terminate the input and output circuits (connectors, clamps, etc.).

The diagram should be drawn for the mode when the product is switched off. If the mode is different, then the mode for which the circuit is drawn is indicated in the diagram field.

All elements and connections between them in the diagram are depicted using symbols in accordance with the current state standards and placed in such a way that the diagram is the most visual, easy-to-read.

Diagrams are recommended to be drawn using the tape method: the conventional graphic designations of devices and their components that are part of the same circle are depicted sequentially one after the other in a straight line, and individual circles are depicted as parallel horizontal or vertical tapes.

Elements that are partially used in the product may not be shown in full, but only those parts that are used.

The leads of unused parts of the symbols should be drawn short.

It is allowed to merge several electrically unconnected communication lines into one line. In this case, each line at the point of merging at both ends shall be marked with symbols (numeric or alphanumeric).

The diagram is allowed to indicate the characteristics of the input circuits of the products (frequency, voltage, current, resistance, etc.), as well as the parameters to be measured at the control contacts. Inscriptions, signs or graphic symbols to be applied to the product shall be placed near the corresponding elements in quotation marks.

It is allowed to indicate the addresses of external connections of the input and output circuits of this product, if they are known.

Conventional graphic designations of input and output elements - connectors, boards, etc. - may be replaced by tables of arbitrary sizes. Tables are assigned the position designations of the elements they replace. The order of the contacts in the table is determined by the convenience of building the circuit.

All elements in the diagram must have an alphanumeric positional designation (PD), which is written only in capital letters of the Latin alphabet and Arabic numerals, in the same font, in one line without spaces (R1, C25, ...), to the right of the symbols or above them (state standart 2.710-81). Serial numbers are assigned in the direction from top to bottom, from left to right within the element type. If the diagram is executed on several sheets, the PB is continued. Type and number are mandatory parts of the PD.

When combining elements into functional groups, the PDs of the elements are placed within the group and assigned to the group.

It is allowed to place on the field of the diagram:

- indications of brands, cross-sections and colours of wires and cables connecting elements, devices, functional groups;
- information on specific requirements for electrical installation of the product.

The symbols can be made in a combined or spaced manner:

- in the combined method, the component parts of the element are depicted in the diagram as they are placed in the product, i.e. together;
- in the separated method, the component parts of the element are placed in different parts of the diagram as it is determined by the sequence of the product's operation. In this case, the sequence number of the part of the element is added to the PD, separated by a dot (DA1.2).

Each schematic must have a list of elements (LE), in which all the elements depicted in the schematic are recorded.

The list of elements shall be filled in by groups of elements in the alphabetical order of their PD.

The " Designation " column should indicate: the type of element, its parameters and the designation of the document according to which it is used (standarts), for example,

<i>CI</i>	<i>K53-14 – 16 V – 22mcF ± 20 %</i>	<i>OGO.464.139 TU</i>
<i>DA1</i>	<i>KP142EH5A</i>	<i>bKO.348.634-02 TU</i>
<i>R1</i>	<i>CIИ5-2 – 1 Bm – 100 Om ± 5 %</i>	<i>OGO.468.559 TU</i>

The LE is placed on the first sheet of the diagram or executed as a separate document.

In the first case, it is placed above the main inscription, but not closer than 12 mm (continuation - to the left of the main inscription). In the second case, it is placed on A4 sheets with the main inscription in Form 2 and placed

in the appendices of the explanatory note. In this case, the name of the product is indicated in column 1 of the main inscription, and the "List of elements" is indicated below.

If the scheme includes functional groups, then the elements that are not included in the group are first recorded in the LE, and then the LD of the functional group, the name of the group (which is underlined), and their number are indicated. Next, record the elements that are included in the group according to the above rules.

If the schematic has microcircuit blocks that do not have power supply terminals, a table of the form is drawn up in the free field of the schematic:

Table for connecting microcircuits to power supply buses

<i>Bus</i>	<i>Output microschem</i>		
	<i>DD1, DD4</i>	<i>DD2</i>	<i>DD3, DD5 ... DD8</i>
<i>+ 5 V</i>	<i>20</i>	<i>16</i>	<i>14</i>
<i>0 V</i>	<i>10</i>	<i>08</i>	<i>07</i>

7.3.5 Connection diagrams

The wiring diagram (State standard 2.702:2013) shows all devices and elements that are part of the product and their connections - wires, harnesses, cables, input and output elements (connectors, clamps, boards, etc.).

The wiring diagram shows:

- devices - in the form of rectangles and simplified external outlines;
- elements - in the form of symbols, rectangles, or simplified external outlines.

The rules for depicting input and output elements established for schematic diagrams also apply to connection diagrams. Connectors may be shown without individual contacts.

In general, wires, groups of wires, harnesses, and cables are shown in the diagram as separate lines with a thickness of 0.4 - 1 mm. Wires that run in the same direction in the diagram may be merged into a common line with the image when approaching the contacts of each wire separately.

Wires, harnesses, cables, and cable cores must be numbered separately within the product. Their designation on the diagram is applied in different ways: cable numbers are put in circles placed in the breaks in the cable images near the branching points; harness numbers are put on the shelves of the lines - footnotes near the branching points. It is permitted to write the cable designation above the cable if the connection is unambiguously readable from the diagram.

It is permitted to place the necessary technical instructions on the diagram (above the main inscription), for example, the values of the permissible

distances between wires, harnesses and cables.

The diagram must also contain information about the wires and cables (brand, wire cross-section, number and cross-section of cores in the cable, etc.), which are placed either near the lines that represent the wires and cables or in the connection table. The form of the connection table is chosen by the schematic designer depending on the information to be included in the schematic (state standart 2.702:2013, Figure 26). The table is placed on the first sheet of the diagram above the main inscription at a distance of no closer than 12 mm from it (continuation - to the left of the main inscription) or as an independent document in A4 format with the main inscription in Form 2.

In the table, first record the individual wires, and then the harnesses of wires and cables in ascending order of their numbers. In the "Notes" column, enter data on insulating tubes, etc.

7.3.6 Wiring diagrams, general diagrams and layout diagrams

The wiring diagram shows the product in the form of a rectangle; input and output elements (connectors, clamps, etc.) are shown in the form of symbols with position designations in accordance with the electrical circuit diagram. At the end of the wires and cables of external installation, which are connected to the input and output elements, they are marked with the necessary data on the product connection. The image of the input and output elements in the middle of the graphic designation of the product must correspond to their actual location in the product.

On the electrical general diagram, the elements that make up the device complex are depicted in the form of rectangles, conventional graphic designations, or external outlines. Graphic designations of devices and elements, including input and output, should be placed close to their actual location in the product.

Information about the elements and devices (their name, type and designation of the document on the basis of which they are used) is placed near the graphical designations of elements and devices. If there are a large number of elements, this information is given in the list of elements in the form given for the schematic diagram. In this case, positional designations are placed next to the graphical designations of elements and devices.

In general diagrams and wiring diagrams, wires, harnesses, and cables are shown as separate lines with their serial numbers within the product (through numbering of wires, harnesses, and cables is allowed if the wires included in the harnesses are numbered within each harness).

The designations of wires, cables and harnesses, as well as the necessary information about them, are recorded in the same way as in the wiring diagrams.

The layout diagram shows the relative position of the equipment components.

The electrical layout diagram depicts the components of the product in the

form of simplified external outlines or conventional graphical symbols (if necessary, the connections between them are drawn), as well as the structure of the room or the area where these components will be placed. The location of the graphic designations of the component parts shall correspond to their actual location in the structure. The diagram contains information about the components: name, type and designation of the document on the basis of which they are used. Near (inside) the graphical representations of the component parts.

If there is a large number of component parts, the information is recorded in the list of elements in the form provided for electrical schematic diagrams.

8 ADMISSION TO THE DEFENSE OF MASTER'S THESIS

After completing the MQT, the student receives admission to the defense of the master's qualification thesis, which involves the following sequence of steps:

- submission of the master's qualification work completed by the student to the power station and system department by the deadline specified in the individual assignment (no later than seven days before the start of the work of the examination commission and defense of the MQT);
- checking the submitted master's thesis for plagiarism;
- preliminary defense of the master's thesis.

The student of higher education submits in electronic form an explanatory note of the completed master's qualification work to the responsible person of the ESS department for its verification for the absence of academic plagiarism. Within no more than 5 days from the date of submission of materials, they are checked for the possible presence of textual borrowings. The results of the check are drawn up as "Protocol of checking the master's qualification work" and are attached to the MKR as a mandatory appendix (see appendix C).

"Protocol of verification of master's qualification thesis" is the basis for its admission to preliminary defense or finalization.

9 MASTER'S THESIS PRESENTATION

Presentation of master's qualification theses using remote technologies. Preliminary defense of master's qualification works, consultation before the defense must be conducted using audio or video conferences according to the approved schedule. During the preliminary defense of master's qualification works, consultations before the defense, it is necessary to carry out a preliminary check of the technical parameters of setting up communication with education seekers, to eliminate the identified problems [1].

In case of force majeure circumstances during the defense of the master's thesis, the student must immediately notify the examination commission (EC) or another responsible person about these circumstances using a specified communication channel (telephone, messenger, etc.) with a mandatory photo or video - fixation of objective factors preventing its completion. Under these circumstances, the possibility and time of re-defense is determined by the examination commission (EC) and the dean's office/directorate, with notification to the educational department on an individual basis (taking into account the possibility of postponement to a reserve day).

Applicants who are admitted to the defense of the master's qualification thesis, but for objective reasons cannot participate in it using the specified technical means, must provide the dean's office/directorate and the examination commission (head of the examination commission) with supporting materials before the defense begins. In such a case, the examination committee should choose an alternative option for the defense of the master's qualification thesis, which would ensure the identity of the applicant and compliance with academic integrity.

Master's qualification work as a form of attestation of students of higher education is carried out in compliance with the current requirements approved by the Regulation [1]. At the time of defense of the master's qualification thesis, its paper copy with the applicant's handwritten signature must be on the examination board (at the graduation department at the technical secretary of the EC), as well as the supervisor's and opponent's feedback on the master's qualification thesis (photocopies, scans). Sending a paper copy of the master's qualification thesis can be done by postal means or, if there is another possibility, in any other way.

If at the time of presentation of the master's qualification thesis, the graduation department did not receive a paper copy signed by the candidate, then before the defense the candidate must send an electronic copy of the master's qualification thesis to the examination committee (technical secretary). At the same time, at the beginning of the defense procedure, the technical secretary of the EC, in the presence of the members of the EC and the applicant, must announce before the address of the applicant the phrase: "Do you, (name of the applicant), confirm the sending (date) of the master's qualification thesis on the topic "Topic of the master's qualification thesis" in total (the full number of

pages with attachments) pages to e-mail (Vinnytsia National Technical University)?" The applicant's answer must be recorded on the video recording of the defense.

The decision of the EC on the result of the defense of the master's qualification work comes into effect after the technical secretary of the EC receives a paper copy of the work following Clause 12.4 of the Regulation [1] and after the completion of all supporting documents.

During the period of restrictive measures (during quarantine), the attestation process of higher education applicants at the second (master's) level of higher education must take place publicly in the form of defense of a master's qualification thesis using distance learning technologies in synchronous mode (video conference). At the same time, digital recording (video recording, audio recording, photo recording, etc.) of the attestation process in the form of defense of the master's qualification thesis must be carried out.

For the defense of master's qualification works, it is allowed, as an alternative to a synchronous speech, to offer applicants to send video recordings of their speeches (presentations) to the EC in advance so that the applicant himself can be seen on the recording, his identity can be identified and the fact of his speech can be certified. Questions and answers to the applicant must be conducted synchronously (publicly).

The digital record of the process of defense of master's qualification theses must be kept at the graduation department for at least one year.

10 CRITERIA FOR EVALUATING THE QUALITY OF MASTER'S QUALIFICATION THESES

The presentation of the master's qualification work is evaluated according to the point scale and according to the ECTS scale (Table 10.1).

Table 10.1 – Evaluation criteria for master's qualification work

Mark	
According to the point scale (number of points) e	According to the ECTS
90-100	A
82-89	B
75-81	C
64-74	D
60-63	E
35-59	FX
0-34	F

The grade "A" according to the ECTS system can be assigned only if, at the defense, the student demonstrated a free and deep mastery of the content of the master's qualification thesis, used illustrative material, answered all the questions asked by the members of the examination committee accurately and completely, and is fluent in scientific terminology.

The grade "B" according to the ECTS system is given if, at the defense, the student showed a free and deep mastery of the content of the master's qualification work, used illustrative material, however, when answering questions, the student made minor inaccuracies, which he was not able to fully correct after they were paid attention to by the members of the examination commission, mainly have scientific terminology.

The grade "C" according to the ECTS system is awarded if the student showed at the defense that he basically knows the content of the master's qualification thesis, illustrative material was used during the report, minor inaccuracies were made by the student when answering questions, which he, however, did not fully understand to correct after they have been brought to the attention of the members of the examination board, mainly has scientific terminology. During the report, illustrative material was used, which also contained some errors and inaccuracies.

The grade "D" according to the ECTS system is awarded if the student has shown at the defense that he basically knows the content of the master's qualification work, however, the report contains insignificant errors. During the report, illustrative material was used, which also contained some errors and inaccuracies. The answers to the questions of the members of the examination committee were not quite clearly formulated. The student did not use some

scientific terms for their exact purpose.

The grade "E" according to the ECTS system is assigned if the student has shown in the defense that he basically knows the content of the master's qualification work, however, the report was constructed illogically and contains errors. During the report, illustrative material was used, which also contained some errors and inaccuracies, and when commenting on which the student encountered certain difficulties that he had to overcome. The answers to the questions of the members of the examination commission were vaguely formulated. The student did not use some scientific terms for their exact purpose.

The grade "FX" according to the ECTS system is assigned if the student has shown in the defense that he does not know part of the content of the master's qualification work, his report is illogical and contains serious errors, and a number of conclusions are incorrectly substantiated or are incorrect at all. Illustrative material was used during the report, but the student could not meaningfully comment on it. The answers to the questions of the members of the examination commission were vague and superficial. Knowledge of scientific terms is unsatisfactory, for items 1-4 the average grade did not exceed "E".

Evaluation of the quality of performance and defense of the master's qualification work is carried out according to the following criteria:

1 – the importance of the obtained results and the quality of the preparation of the master's qualification work;

2 – the quality of the presentation of the results of the master's qualification work at the official defense;

3 – approvals and publication of the results of the master's qualification work, connection with scientific programs, plans, topics (Table 10.2).

Table 10.2 – Indicative criteria for evaluating the quality of the execution and defense of the master's qualification work

№	Approximate evaluation criteria	Number of points
1	<p>The importance of the obtained results and the quality of the preparation of the master's qualification work:</p> <ul style="list-style-type: none"> - accuracy and correctness of tasks and conclusions; - complete justification of the relevance of the chosen work topic; - the clarity of setting the goal and tasks of the qualification work and the completeness of their implementation; - the correctness of the chosen methods and approaches in the qualification work for solving the task; - compliance with the scientific and technical style of presentation of information. 	up to 50 points

Continuation of table 10.2

2	The quality of the preparation of the master's qualification work in accordance with the current requirements.	up to 10 points
3	The quality of the presentation of the results of the master's qualification work at the official defense (the quality of the report and presentation, as well as the answers to questions).	up to 30 points
4	<p>Approvals and publication of the results of the master's qualification work, connection with scientific programs, plans, topics:</p> <ul style="list-style-type: none"> - participation in thematic conferences, competitions of student scientific works; - availability of publications based on the results of master's qualification work; - implementation of the results of the master's qualification work into practice; - execution of master's qualification work on the order of enterprises, institutions and organizations; - connection of master's qualification work with scientific programs, plans, topics of the graduation department. 	up to 10 points
	The maximum score is	100 points

11 ACADEMIC INTEGRITY IN PERFORMING AND ASSESSING MASTER'S THESIS

According to the Laws of Ukraine "On Higher Education", "On Education" (edition No. 2145-VIII dated 05.09.2017), academic integrity is defined as "a set of ethical principles and rules that should be guided by participants in the educational process during learning, teaching and proceedings scientific (creative) activity in order to ensure trust in the results of training and/or scientific (creative) achievements".

According to Clause 8, Part 2, Art. 16 of the Law of Ukraine "On Higher Education", the system of internal quality assurance of higher education must ensure "observance of academic integrity by employees of higher education institutions and students of higher education" [8].

In accordance with Part 2 of Art. 42 of the Law of Ukraine "On Education", the observance of academic integrity by pedagogical, scientific-pedagogical and scientific workers provides [9]:

- references to sources of information in case of use of ideas, developments, statements, information;
- compliance with the legislation on copyright and related rights;
- provision of reliable information about research methods and results, sources of used information and own pedagogical (scientific-pedagogical, creative) activity;
- control over compliance with academic integrity by education seekers;
- objective assessment of learning outcomes.

Compliance with the requirements of academic integrity is the duty of both scientific and pedagogical workers and students of higher education (Articles 58, 63 of the Law of Ukraine "On Higher Education").

The Law of Ukraine "On Education" defines the main types of violations of academic integrity and the responsibility of participants in the educational process for such violations. In particular, in accordance with Part 4 of Art. 42 of the Law, violations of academic integrity are academic plagiarism, self-plagiarism, fabrication, falsification, plagiarism, deception, bribery, and biased evaluation. This list can be supplemented by special laws, in particular, the Law of Ukraine "On Higher Education".

The academic responsibility of the applicant and the supervisor of the qualification work is assumed for the following violations.

Academic plagiarism:

- plagiarism of fragments of written works and full texts;
- plagiarism of ideas, data, models, illustrations, etc.;
- lack of proper references;
- citation errors.

Self-plagiarism:

- duplication of publications – publication of the same scientific work (completely or with minor changes) in several editions, as well as re-publication (completely or with minor changes) of previously published articles, monographs, other scientific works as new scientific works;
- duplication of scientific results – publication in full or in part of the same scientific results in various articles, monographs, other scientific works as new results that are published for the first time;
- presentation of the same results in reports on the implementation of various scientific projects as those obtained during the implementation of the corresponding project;
- re-submission by students of written works that have already been submitted as reports from other disciplines, without the teacher's permission;
- aggregation or addition of data – combining previously published and new data without their division with relevant references to the previous publication;
- re-analysis of previously published data without reference to the previous publication of these data and their previously performed analysis.

Fabrication:

- citation of fictional or unverified data, including statistical data, results of experiments, calculations or empirical studies, photographs, audio and video materials, etc., in written works of applicants and in scientific works;
- reference to fictitious sources of information or intentional reference to a non-genuine source;
- attributing to others texts, opinions or ideas that they did not express or publish.

Falsification:

- unjustified correction of the results of one's own scientific research or performance of educational tasks (one that is not based on repeated or additional research, measurements or calculations, correction of identified errors, etc.);
- citation in written works of applicants and in scientific works of deliberately changed literary data and data obtained from other sources; in particular, statistical data, results of experiments, calculations or empirical studies, photographs, audio and video materials, etc. without proper substantiation of the reasons and indication of the method of their adjustment;
- providing incomplete or distorted information about the approval of research and development results.

Deception:

- inclusion of persons who did not take qualified participation in their preparation as co-authors of scientific publications;
- non-inclusion in co-authors of scientific publications of persons who took qualified participation in their preparation;
- presenting as the results of one's own work works commissioned by other persons, or works for which the real authors have given consent for such use;

- submission or presentation by different persons of works with the same content as a result of their own educational activity;
- writing other people's versions of tasks at control events;
- use of a system of hidden signals (sound, gestures, etc.) when performing group control measures with the same options;
- non-independent performance of tasks in cases where receiving assistance is not allowed, or failure to specify information about received assistance, consultations, cooperation;
- passing knowledge control procedures by fake persons;
- simulation of deterioration of health, illness in order to avoid control measures;
- providing feedback or reviews on scientific or educational works without proper examination of them.

Non-objective assessment:

- deliberate overestimation or underestimation of the learning outcomes of education seekers;
- untimely notification of education seekers about the system of evaluation of learning results;
- application of an evaluation system that does not correspond to the declared goals and objectives of the topic, discipline, practice, educational program, etc.;
- lack of objective evaluation criteria.

Part 5 of Art. 42 of the Law of Ukraine "On Education" are as follows:

- refusal to award a scientific degree or assign a scientific title;
- deprivation of the awarded scientific (educational-creative) degree or assigned scientific title;
- refusal to assign or deprivation of the assigned pedagogical title, qualification category;
- deprivation of the right to participate in the work of bodies defined by law or to hold positions defined by law.

Part 6 of Art. 42 of the same Law defines the main types of responsibility of education seekers for violation of academic integrity, which are:

- repeated assessment (test, exam, credit, etc.);
- repeating the relevant educational component of the educational program;
- deductions from the educational institution (except for persons who obtain general secondary education);
- deprivation of an academic scholarship;
- Deprivation of tuition benefits provided by the educational institution.

The system of internal quality assurance of VNTU provides for the creation and ensuring the functioning of an effective system for the prevention and detection of academic plagiarism (Article 16 of the Law of Ukraine "On Higher Education").

Prevention of plagiarism in the academic environment of the university is

carried out by the Center for Monitoring the Quality of Education of VNTU in accordance with the "Regulations on the prevention of academic plagiarism and the procedure for its detection in scientific, qualification, educational and scientific-methodological works at the Vinnytsia National Technical University".

The basic software and technical means for checking for signs of academic plagiarism at VNTU are online information systems UNICHECK (Unicheck.com) and StrikePlagiarism (StrikePlagiarism.com). The procedure for checking qualification works is specified in the "Regulations on prevention of academic plagiarism and the procedure for its detection in scientific, qualification, educational and scientific-methodical works at the Vinnytsia National Technical University".

The student of higher education submits written work in electronic form to the person responsible for the graduation department to detect and prevent academic plagiarism.

Within no more than 5 days from the date of submission of the materials, the master's qualification thesis is checked for the presence of textual borrowings. The results of the inspection are drawn up as the "Protocol of inspection of educational (qualification) work" and are attached to the work as a mandatory appendix.

The protocol for checking the educational (qualification) work is the basis for admitting the master's qualification work to the preliminary defense or finalization.

The rector, the vice-rector for scientific work and international cooperation, the vice-rector for scientific-pedagogical work and the organization of the educational process, the head of the commission for academic integrity, the responsible person for the graduation department have access to review the results of the examination of works.

The criterion of the academic quality of the master's qualification work is the indicator of the level of originality of the work in percentages, obtained with the help of software and technical means of checking for plagiarism, which is reduced by the percentage of legitimate borrowings. Borrowings identified in the text of the work are considered legitimate if they are:

- proper names (names of objects, institutions, bibliographic references to sources, etc.);
 - established phrases that are characteristic of a certain field of knowledge;
 - properly formatted citations;
 - self-citation (text fragments belonging to the author of the work, published or made public by him in other works).
- The head of the graduation department, in case of disagreement of the student with the decision made based on the results of the uniqueness check, appoints a committee of department members (the head of the department and two persons from among the leading scientific and pedagogical employees of the department). The final decision on

the results of determining the degree of uniqueness of the MQT is taken at the meeting of the Power station and system department, taking into account the conclusions of the commission. The student must be allowed to prove the independence of his master's qualification work. The procedure for submitting an appeal and its consideration is given in the Regulation on Detection and prevention of Academic Plagiarism at the Vinnytsia National Technical University. In case of disagreement with the commission's decision, the student of higher education has the right to submit a written appeal within three days to the head of the appeal commission regarding the prevention of plagiarism. The application is accompanied by a printed report on the verification of the work generated in the relevant anti-plagiarism system or a report based on a file generated in one of the legally functioning anti-plagiarism services in Ukraine (Unicheck, StrikePlagiarism.com) on a paid basis. The head of the VNTU appeals commission holds a meeting within a week from the moment the application is submitted, based on the results of which the appeals commission forms a conclusion. Samples of documents for checking qualification works are given in the Regulation on detection and prevention of academic plagiarism at the Vinnytsia National Technical University [11].

LIST OF REFERENCES

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APPENDIX A

Example of the title page of the master's thesis

Vimnitsa National Technical University

Faculty of Electric Power Engineering and Electromechanics

Department of power plants and systems

MASTER'S QUALIFICATION THESIS

on the topic:

«Electric part of condensing power plant installed capacity 2500 MW with an analysis of conditions of the surge arresters operation»

Performed by: student of the 2nd
group ES-21m
specialty 141 – power engineering
electrical engineering and electric
educational program "Power plant

(code and name of the field of training, specialty)

H6

(signature)

Supervisor: Ph.D., associate prof

E

(surname)

« »

2

Admitted to defense

APPENDIX B

Example of an individual task for master's qualification thesis

Vinnitsa National Technical University
Faculty of Electric Power Engineering and Electromechanics
Department of power plants and systems
Level of higher education II (master's)
Field of knowledge - 14 "Electrical engineering"
Specialty - 141 - "Electric power engineering, electrical engineering ;
electromechanics"
Educational and professional program – Power plants

CONFIRM
Head of the PPS d
DScTech, prof. Kor

TASK

FOR THE STUDENT'S MASTER'S THESIS

Hei Xiangpin

(full name)

1. The topic of the thesis. Electric part of condensing power plant i
2500 MW (5x500) with an analysis of conditions of the surge arreste
supervisor Ph.D., docent, associate prof. of dep. PSS Hunko Iry
approved by the order of the higher educational institution from 15.0
№ 205-A
2. Deadline for submission of thesis by the student
3. Initial data for thesis: List of literary sources by topic of
periodicals. Input data for computational experiments: the installed
station is 2500MW (5x500); $U_{nom} = 500$ kV; fuel: coal; Electr
station: a) the maximum load of the district is 400 MW; b) mains vo
c) the maximum power delivered to the system is 1500 MW.
4. Content of the text part: Introduction: 1 Technical and economi

6. Consultants of thesis chapter

Chapter	Surname, initials and position of the consultant	Signat
		issued the task
Special part	Supervisor Hunko Iryna, Ph.D., docent, associate prof. of dep. PSS	
Labor protection	Rubanenko O. E. Ph.D., prof., professor of dep. PSS	

7. Issue date of the task _____

CALENDAR PLAN

№	The title of the stages master's qualification work	The term performance stage	
		begin	
1	Making a technical task		
2	Technical and economic justification of the design of condensing power plant		
3	The electrical part		
4	The relay protection and automation		
5	An analysis of conditions of the surge arresters operation		
6	Labor protection		
8	Issuance of an explanatory note		
9	Execution of the graphic part and design of the presentation		

APPENDIX C.1

Example of abstract of master's qualification thesis in English

ABSTRACT

Sydorenko Olena «The electrical part of a 120 MW hydroelectric power station with units CB-546/90-32 with a study of the features of operation of high-voltage circuit breakers». Master's qualification thesis in specialty 141 «Electric power, electrical engineering and electromechanics». Vinnytsia: VNTU. 2022. 107 pp.

In Ukrainian language. Bibliographer: 34 titles; fig.: 24; tabl. 35.

In the master's qualification work, the electrical part of the hydroelectric power plant (HPP) with a capacity of 120 MW was designed. The technical and economic substantiation of the design of the hydroelectric power station was carried out. The electrical part of the station was designed: the electrical load schedules were calculated, the main and auxiliary equipment was selected, the structural diagram of the station, the diagram of the 110 kV open switchgear and the diagram of own needs were selected. Based on the calculation of short-circuit currents, switching devices, busbars, measuring transformers, means of limiting overvoltages, a storage battery were selected, and lightning protection and grounding device of the 110 kV open switchgear were also calculated. The problems of operation of high-voltage circuit breakers were investigated. An analysis of potentially dangerous and harmful production factors at the power plant was carried out, and safety measures for the life of the personnel in emergency situations were proposed.

Keywords: hydroelectric plant, generator, transformer, open switchgear, storage battery, high-voltage circuit breaker

APPENDIX C.2

Example of abstract of master's qualification thesis in Ukrainian

АНОТАЦІЯ

УДК 621.311.1

Сидоренко Олена Василівна «Електрична частина гідроелектростанції потужністю 120 МВт з агрегатами типу СВ-546/90-32 з дослідженням особливостей експлуатації високовольтних вимикачів». Магістерська кваліфікаційна робота за спеціальністю 141 «Електроенергетика, електротехніка та електромеханіка». Вінниця : ВНТУ. 2022. 107 с.

На укр. мові. Бібліогр.: 34 назв; рис.: 24; табл. 35.

В магістерській кваліфікаційній роботі спроектована електрична частина ГЕС потужністю 120 МВт. Проведено техніко-економічне обґрунтування проектування гідроелектростанції. Спроектовано електротехнічну частину станції: розраховано графіки електричних навантажень, обрано основне та допоміжне обладнання, обрано структурну схему станції, схему відкритої розподільної установки (ВРУ) 110 кВ і схему власних потреб. На підставі розрахунку струмів короткого замикання обрано комутаційні апарати, ошиновку, вимірювальні трансформатори, засоби обмеження перенапруг, акумуляторну батарею, а також розраховано блискавкозахист та заземлювальний пристрій ВРУ-110 кВ. Досліджено задачі експлуатації високовольтних вимикачів. Проведено аналіз потенційно небезпечних і шкідливих виробничих факторів на електростанції та запропоновано заходи безпеки життєдіяльності персоналу в умовах надзвичайних ситуацій.

Ключові слова: гідроелектрична станція, генератор, трансформатор, відкрита розподільна установка, акумуляторна батарея, високовольтний вимикач.

APPENDIX D

Example of the content of the master's thesis

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