MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
"IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE"

MASTER'S THESIS: implementation, design, and defense

Recommended by the Methodological Council of the Igor Sikorsky Kyiv Polytechnic Institute
as a tutorial for master's degree applicants on the educational program
"Engineering of intellectual electrotechnical and mechatronic complexes"
of the specialty 141 Electric Power Engineering, Electrotechnics and Electromechanics

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This tutorial is designed to familiarize applicants with the features of working on a master's thesis, requirements, rules for the design and grading of final qualification works for a master's degree. The educational publication is intended for applicants studying in the specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics" of the Department of Automation of Electrical and Mechatronic Complexes of the Educational and Scientific Institute of Energy Saving and Energy Management of Igor Sikorsky Kyiv Polytechnic Institute. Igor Sikorsky and will also be useful for other specialties.

UDC 621.3

Електронне мережеве навчальне видання

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МАГІСТЕРСЬКА РОБОТА:
реалізація, оформлення та захист

(Англійською мовою)

Даний навчальний посібник призначений для ознайомлення здобувачів з особливостями роботи над магістерською дисертацією, вимогами, правилами оформлення та виставлення оцінок випускних кваліфікаційних робіт для здобуття ступеня магістра. Навчальне видання розраховане на здобувачів, які навчаються за спеціальністю 141 «Електроенергетика, електротехніка та електромеханіка» кафедри автоматизації електротехнічних та мехатронних комплексів Навчально-наукового інституту енергозбереження та енергоменеджменту КПІ ім. Ігоря Сікорського та також буде корисним для інших спеціальностей.

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CONTENT

INTRODUCTION

The textbook was developed on the basis of the "Regulations on the examination commission and certification of higher education applicants in Igor Sikorsky Kyiv polytechnic institute" approved and put into effect by the order of 01.10.2020, No. 7/178, as amended by the orders of 19.04.2021, No. NU/71/2021, of 03.05.2022, No. NAS/130/2022 [1].

The textbook defines the requirements for the organization, volume, structure, content and design of the qualification work of students of the second (master's) level of higher education in the specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics" of the educational and professional program "Engineering of intelligent electrical and mechatronic complexes" and regulates the responsibilities of applicants, supervisors, consultants and reviewers of the master's dissertation.

The master's thesis is the final stage of study in the educational program of the second level of higher education of the master's degree and takes place after the completion of the full theoretical course provided by the curricula and practice. Based on the results of the master's thesis defense, the examination committee makes a decision on awarding the applicant a master's degree in electric power engineering, electrical engineering and electromechanics.

1. GENERAL PROVISIONS

A master's thesis is a type of qualification work of an applicant for a master's degree, designed to objectively control the level of formation of competencies of a research and innovative nature for conducting research and/or conducting innovative activities in the field of electrical engineering.

The dissertation should include the results of theoretical and experimental research aimed at solving urgent problems in the field of electrical engineering and correspond to the current state of scientific knowledge, have logical completeness and indicate that the master's student has the appropriate competencies in the specialty 141 Electric Power Engineering, Electrical Engineering and Electromechanics.

A master's thesis have to be made by a master's student independently on the basis of materials collected by him during the period of study, practice and research work and should be characterized by the relevance, originality, novelty of the developed solutions and the results obtained.

When performing the final qualification work, the master student must show his ability and skills, based on the obtained in-depth knowledge, skills and formed general cultural, general professional and professional competencies, independently conduct scientific research, formulate and solve the problems of his professional activity at the modern technical level, interpret, analyze and summarize the results obtained, professionally present special information, scientifically argue and defend your point of view.

Any forms of borrowing previously obtained scientific and practical results without reference to the authors and sources of borrowing are not allowed.

The master's thesis is carried out under the supervision of a supervisor and scientific consultants.

1.1. Classification of master's theses

According to the content and industry affiliation, the applicant's master's thesis can be classified as follows:

a) by the nature of the performance:

– individual – is the most common type, which involves the student's independent work on the topic of the dissertation under the guidance of a scientific and pedagogical worker;

– complex – those in which the topic in terms of volume/content requires the involvement of a group of students of one or more specialties. In all cases, they should have logically complete and not duplicated in content parts, which are performed according to an individual task by each student, and a general part that connects individual parts to a single master's thesis and determines its complexity;

b) by content and industry affiliation:

– design – involve the design and calculation of new technical devices and systems or the modernization of existing ones in order to improve their characteristics;

– technological – involve the development of new production facilities, technological processes, reconstruction or technical re-equipment of existing enterprises, the introduction of technological processes, etc.;

– engineering and economic – involve the development of cost-effective productions, processes, systems and measures for product quality management, project management, etc.;

c) by practical orientation:

– real – related to the research work of the department; or made by order of external organizations (as evidenced by the presence of a properly executed terms of reference); or the results of the work are brought to a state that allows them to be used for implementation in science, technology, technology, modern production (confirmation is the act of implementation of the results or the request of the enterprise for the transfer of materials of work); or the author has received documents of protection, published articles in professional scientific journals, received samples of materials (products), made working models of equipment, etc.;

– academic – involves the solution of educational tasks by the applicant, the solution of which requires certain competencies, knowledge and professional skills from him in accordance with the educational program of this level of higher education.

The content and scope of the qualification work of the appropriate level of higher education should ensure the diagnosis of the degree of formation of competencies in accordance with the requirements of higher education standards and comply with: the time for implementation determined by the curriculum of the relevant educational program, the requirements for qualification work in this specialty, the issued assignment for work.

1.2. Organization of master's thesis

Stages of preparation of a master's thesis.

Organizationally, the process of performing certification work consists of the following stages:

– preparatory, which begins with the student's choice of a topic and receiving an individual task from the supervisor on issues that need to be resolved during the practice on the chosen topic (familiarization with the state of the problem, collection of factual materials, conducting the necessary observations, experiments, research, etc.), includes mastering the internship program and ends with the preparation and defense of a report on its passage;

– the main one, which begins immediately after the defense of the practice report. At this stage, the attestation work must be fully completed, checked by the supervisor and consultants, as well as pass the check for academic plagiarism;

– final, which includes receiving feedback from the supervisor and review. Completed attestation works with the feedback of the supervisor are submitted by students to the graduating department no later than one week before the day of defense to the examination commission. The head of the department, based on the results of the preliminary defense and familiarization with the submitted materials, makes a decision on admission to the defense and puts the visa on the title page of the student's master's dissertation. The decision of the head of the department is formalized by the relevant minutes of the meeting of the department.

To supervise students who have to prepare master's theses, scientific and pedagogical staff of the Department of automation of electrical and mechatronic complexes, who have scientific degrees (academic titles), are appointed. Teachers who supervise

students for the first time can be assigned consultants by the decision of the department - experienced scientific and pedagogical staff of the department with an indication of the time they spend. By the decision of the department or at the request of the supervisor, consultants on specific production, technical, scientific issues may be appointed; issues that fall within the competence of the departments that teach academic disciplines of the cycle of general preparation of the curriculum; feasibility study of decisions made and calculations of economic effect, startup projects; issues of ecology, life safety and labor protection, etc. If the decision of the department to appoint consultants on certain issues is mandatory for all students, then this is indicated in the working curriculum of the relevant specialty, which indicates the specific time allotted to consultants per student, and the department that allocates teachers for counseling.

The main stages of work on a master's thesis:

a) selection of the direction of research, determination and approval of the topic of the master's dissertation;

b) drawing up a task for the implementation of a master's thesis and a schedule of work;

c) review and analysis of scientific and technical literature (books, journal articles, reference and information publications, patents, educational and methodological manuals, legal and regulatory documents, electronic databases, information retrieval systems on the Internet, etc.) related to the problem under study and reflecting its current state;

d) performing a patent search, if the task involves the development of a new design of a product or a new method of its manufacture, application;

e) planning and conducting theoretical and experimental research, developing models, developing objects, systems, technologies, performing calculations, etc.;

f) analysis of the results of research (development), formation of conclusions and recommendations for the use of the results obtained;

g) registration of research materials (developments) as a master's thesis in accordance with the established requirements, obtaining feedback from the supervisor;

h) development of presentation material (slides, handouts) on the dissertation and preparation of a report based on the materials of the research;

i) preliminary defense (pre-defense) of the dissertation at the graduating department; j) checking the master's thesis for plagiarism;

k) preparation for defense at the meeting of the Examination Commission (EC), receiving reviews from internal and external reviewers;

l) defense of the master's thesis at the meeting of the EC.

The qualification work must be placed in the depository of the higher education institution.

1.3. Assignment for qualification work

During the preparation of a master's thesis, the applicant must develop the following skills:

- draw up a research plan;
- formulate the purpose and objectives of the study;
- determine the object and subject of research;
- conduct a bibliographic search using modern information technologies;
- use modern methods of scientific research, design, modify existing and develop new methods, based on the tasks of a particular study;
- analyze, synthesize, systematize, classify, substantiate, summarize the data obtained;
- to draw up the results of scientific research in accordance with modern requirements, in the form of reports, theses, articles.

The assignment for the master's thesis (Appendix B) indicates:

- name of the topic of the dissertation;
- a scientific problem and a specific task within the framework of the problem to which the research is directed, proposed methods and approaches to solving the problem, a list of mandatory sections included in the content of the master's thesis, requirements for the design of the dissertation (see paragraph 1.4);
- a list of issues that should be considered in detail and developed in the dissertation;
- a list of graphic and illustrative material to be presented in the dissertation (drawings, diagrams of structures of objects or systems; graphs of dependencies of process

parameters, diagrams, histograms, figures, photographs, etc.).

The assignment for the master's thesis is signed by the supervisor of the dissertation, scientific consultants, the master student and approved by the head of the department.

The task (Appendix B) indicates:

– *the topic of the qualification work* and the *order of the university*, by which it was approved (entered after receiving the order by the dean's office);

– *the deadline for submission of the completed work by the student*, which is established by the decision of the department or the academic council of the institute, taking into account the time required to receive the feedback of the head, the visa of the head of the graduating department on admission to the defense, reviews and submission to the secretary of the EC no later than a week before the defense;

– *object of study.* The name of the system (equipment, device, process, technology, software product, information technology, intellectual work, phenomenon, economic activity, etc.) that gives rise to the problem situation and is selected for research is indicated. The object of research should belong to the class of the generalized object of activity of a specialist of a certain specialty. One of the possible mistakes is when the selected object of research does not belong to a certain class of generalized object of activity of a specialist in this specialty. That's why it is necessary to take the most responsible approach to the choice of the object of research and the topic of the dissertation;

– *Initial data for the master's thesis*. Only quantitative and (and) qualitative indicators (characteristics) of the design object, which it must meet after the completion of the dissertation, are indicated; conditions in which the design object should function (temporal, spatial, climatic, energy, loading, environmental, ergonomic); permissible deviations from the normative values of indicators or errors (maximum, minimum, mean square), etc. The initial data for the dissertation should determine quantitative or (and) qualitative indicators regarding the conditions, means and methods that characterize the direction of the research, specify the methodology for solving theoretical problems and conducting an experiment, if the latter is not the subject of the student's independent choice in the process of performing the work. *It is unacceptable to leave this section of the task blank or to indicate literary sources in it (except for those that provide a description and characteristics of a specific*

prototype object)!

– *A list of tasks that need to be developed.* Specific tasks for individual parts of the qualification work (main, special, economic) are indicated, the sequence and content of which actually determine the student's program of actions and the future structure of the qualification work. The formulation of these tasks for each part of the project should be in the imperative way, that is, begin with the words: "Develop...", "Justify...", "Optimize...", "Analyze...", "Calculate..." etc;

– *list of graphic (illustrative) material.* Determines drawings, diagrams, histograms, figures, etc., which are mandatory for this qualification work;

– *consultants on certain issues (or parts) of the qualification work.* The names of the questions (for example, on the economic justification of the project or simply on economic issues, on the technological part, other special issues) and the academic title, surname, initials and position of the consultant on these issues are indicated;

– the date the assignment was issued;

– Calendar plan for the performance of qualification work.

The assignment is signed by the supervisor of the qualification work, who is responsible for the reality of the implementation and the balance of its volume with the time allotted for the completion of the qualification work, as well as by the student, who certifies the date of receipt of the task for execution by his signature. Tasks are a necessary component of the work. Significant changes to it are allowed, as an exception, by the decision of the graduating department at the request of the supervisor only within a month from the beginning of the qualification work.

The tasks of the master's degree in the educational and professional program involve activities at the innovative level according to an algorithm that contains a procedure for the development and construction of new products and solutions.

1.4. Requirements for the structure and content of the master's thesis

The dissertation is drawn up in accordance with the requirements of DSTU 3008: 2015 "Information and documentation. Reports in the field of science and technology. Structure and Rules of Design" [2]. The master's thesis is submitted in the form of a specially

prepared manuscript in printed form on A4 sheets in Times New Roman font 14 points, line spacing 1.5 lines in hardcover. The approximate volume of qualification works of applicants for a master's degree is more than 80 pages (without appendices).

When making drawings, the state standards of Ukraine, the European standardization system, which is harmonized with the state standards of Ukraine, in some cases, the regulatory documentation of specific enterprises are used. Methodical elaboration of standards is given in textbooks, manuals developed by teachers of university departments [3].

Scope of applications, graphic and illustrative material is agreed by the master student with the supervisor of the dissertation

The dissertation should exactly correspond to the topic of the work and fully disclose it, reflect the initial prerequisites of the scientific research, its entire course and the results obtained. A master's thesis cannot be complicate and descriptive.

The master's thesis has to take into account the requirements for the professional training of a master's student in the specialty 141 "Electric power engineering, electrical engineering and electromechanics" and meet the following general requirements:

- be up-to-date;
- contains elements of scientific research;
- clear, sequence and easy-to-understand presentation of the material;
- performed using modern methods and models as well as with the involvement of specialized packages of computer programs;
- contains convincing arguments, for this purpose, graphic material (drawings, tables, graphs, illustrations, etc.) can be used in the text of the dissertation.

The content of the master's thesis includes:

- justification of the choice of the subject and setting the goals and objectives of the study, performed on the basis of a review of special scientific and technical literature, in particular, taking into account periodicals, patent search results and other sources;
- theoretical and (or) experimental parts, including research methods and tools;
- mathematical models, calculations, design and (or) technological parts;
- obtaining new results and technical solutions that have scientific novelty and

theoretical, practical, applied, or scientific-methodological significance;

- approbation of the obtained results and conclusions in the form of reports at scientific conferences or prepared publications in scientific journals and collections;
- analysis of the results obtained;
- conclusions and recommendations for the use of the results obtained.

The content of the master's thesis should be entirely devoted to the topic of the work, the achievement of the goal, and the solution of the tasks set. Any deviations that are not related to the objectives of the research are unacceptable.

The master's thesis should include:

- formulation of a scientific (scientific and technical) problem, definition of the object, subject and purpose of the study, analysis of the state of solution of the problem based on the materials of domestic and foreign publications (including periodicals), justification of the purpose of the study;
- analysis of possible research methods and options for solving the problem, justified choice (development) of research method (methodology) or technical solution;
- scientific analysis and generalization of factual material used in the process of research or calculations for the selected technical solution;
- presentation of the results obtained and grading of their theoretical, applied or scientific-methodological significance;
- checking the possibilities of practical implementation of the results obtained;
- approbation of the obtained results and conclusions in the form of patents for inventions, utility models, industrial designs, etc., or relevant applications, reports at scientific conferences (not lower than the faculty level) or publications in scientific journals and collections (based on the results of the master's dissertation).

The components of the master's thesis are:

– title page *(*Appendix A*)*;
– assignment for a master's thesis (Appendix B*)*;
– abstract;
– content;
– list of symbols, abbreviations and terms;

– the main part;

– conclusions;

– list of references;

– appendices (if necessary).

The title page is drawn up in accordance with Appendix A. On the title page, in accordance with the title of the topic of the dissertation, the bibliographic code of the UDC is indicated. The requirements for the assignment for the qualification work are given in paragraph 1.3.

The abstract is intended for familiarization with the dissertation. It should be concise, informative, and contain information that allows you to reveal the essence of the research. An abstract of up to 500 words in Ukrainian and foreign languages should reflect the content of the dissertation, in the following sequence:

– information about the amount of work, the number of drawings, illustrations, tables, appendices, sources according to the list of references;

– the reference of the message;

– keywords.

Text abstract has given overall feature thesis in the recommended sequence below:

– *relevance of the topic*. Disclosure of the essence and state of solving a scientific problem (task) and its relevance and significance for the development of the relevant field of science or production, justification of the expediency of the study;

– *connection of the work with scientific programs, plans, topics.* Highlighting the connection of the chosen direction of research with the plans of research work of the department, as well as with sectorial and (or) state plans and programs.

Be sure to indicate the numbers of state registration of research works, as well as the role of the author in the implementation of these research works;

– *Purpose and objectives of the study.* Formulation of the purpose of the work and the tasks that need to be solved to achieve the goal (the goal should not be formulated as "research...", "study..." etc., because these words indicate the means to an end, not the end itself). A goal is a planned outcome of a study. When performing scientific work, it should

be remembered that the purpose of any scientific work is to identify new facts, conclusions, recommendations, patterns or clarify previously known, but insufficiently researched. It is possible to obtain the planned results, gradually achieve the set goal by detailing it in the form of a certain program of purposeful actions – research tasks. The tasks of the study are formulated in two versions: the first – in the form of independently completed stages of the study; The second is as a sequential solution of individual problems of scientific research in relation to the general problem of the entire master's dissertation. The tasks should be formulated and specified very carefully, since the description of their solution constitutes the content of the subsections of each section of the dissertation;

– *object of study.* Definition of the object and subject of research as a category of scientific process. The object of research is a certain system, equipment, device, process, technology, software product, information technology, etc., which gives rise to a problem situation and is selected for research;

– *subject of research.* The subject of the research is certain properties, characteristics of the object to which the research itself is directly directed, since the subject of research determines the topic of the dissertation, which is determined on the title page;

– *Research methods.* Presentation of a list of research methods used to achieve the goal set in the work. It is necessary to list them not in isolation from the content of the work, but briefly and meaningfully defining what exactly was investigated by this or that method. This will make it possible to make sure that the choice of these methods is logical and acceptable;

– *scientific novelty of the results obtained.* A brief annotation of new achievements (decisions, conclusions) received by the master's student personally is submitted. It is necessary to show the difference between the obtained results and previously known ones, to emphasize the degree of novelty;

In a master's thesis, novelty can be reduced to the so-called elements of novelty. Such an element may be the introduction of new concepts, the use of new methodological approaches or data from related sciences, an independent experiment, etc.

– *practical significance of the results obtained.* Submission of information on the application of research results or recommendations for their implementation (use). It is

necessary to give brief information on the implementation of research results, indicating the names of the organizations in which the implementation was carried out, the forms of implementation and the details of the relevant documents;

– *Approbation of the results of the dissertation.* It is indicated at which scientific conferences, seminars the results of the research included in the dissertation were published;

– *Publication.* It is indicated in which articles in scientific journals, collections of scientific papers, materials and abstracts of conferences, patents the results of the dissertation are published;

– *The key words* that are the most important for the disclosure of the direction of the work are formed on the basis of the text of the work and placed at the end of the abstract. A list of 5-15 key words (phrases) is printed in capital letters in the nominative case in a line, separated by commas.

Parts of the abstract from which data are missing should not be indicated.

The content should reflect a specific step-by-step plan for the implementation of the work, its structure. It contains the names and numbers of the initial pages of all sections, subsections and paragraphs (if they have a title), including the introduction, conclusions to the sections, general conclusions, annexes, list of references, etc.

List of symbols, abbreviations and terms.

If specific terminology is used in the dissertation, as well as little-known abbreviations, new symbols, designations, and so on, then their list can be presented in the dissertation in the form of a separate list.

The list should be printed in two columns, in which, for example, abbreviations are given on the left in alphabetical order, and their detailed interpretation is given on the right.

If special terms, abbreviations, symbols, designations, etc., are repeated less than three times in the dissertation, the list is not compiled, and their interpretation is given in the text at the first mention.

The main body of the dissertation contains an introduction, a certain number (3-5) of chapters and conclusions at the end of each chapter, as well as general conclusions of the dissertation. Each chapter starts on a new page.

In the introduction, on the basis of a review of the literature, the state of the scientific

problem (task) and its significance are revealed. Briefly, critically highlighting the work of predecessors, the master student should point out those issues that remained unresolved and, therefore, determine his place in solving the problem. It is necessary to conclude this section with a brief summary of the feasibility of the study. The total volume of the introduction should not exceed 10% of the volume of the main part of the dissertation.

In the following sections, as a rule, they justify the choice of the direction of research, provide methods for solving research problems and their comparative assessments, develop a general methodology for conducting dissertation research. In theoretical works, the methods of calculations, the hypotheses under consideration are revealed, in experimental works – the principles of operation and characteristics of the developed equipment, estimates of measurement errors.

In other chapters, the results of the author's own research are presented with exhaustive completeness, highlighting the new that he brings to the development of the problem. The master's student should assess the completeness of the solution of the tasks, assess the reliability of the results obtained (characteristics, parameters), compare them with similar results of domestic and foreign works, justify the need for additional research, negative results that necessitate the termination of further research.

There should be a clear logical connection between the structural parts of the work, that is, the sections should be interconnected and begin with a brief description of the issues covered in this section in their relationship with the previous and subsequent sections.

At the end of each section, conclusions must be formulated with a brief summary of the scientific and practical results of the part of the study that was considered in the section. The conclusions should not retell what was done in the chapter, but formulate what follows from it.

The conclusions are the final and especially important part of the master's thesis, which should demonstrate the results of the research, the degree of implementation of the set goals and objectives. In the conclusions, a synthesis of all the results of the research and their correlation with the general purpose and objectives of the dissertation is carried out. The most important scientific and practical results obtained in the dissertation are presented, which should contain the formulation of the solved scientific problem (task), its meaning for

science and practice. In the conclusions, it is necessary to emphasize the qualitative and quantitative indicators of the results obtained, to substantiate the reliability of the results. Next, conclusions and recommendations for the scientific and practical use of the results obtained are formulated.

Conclusions are best presented in the form of sequentially numbered paragraphs. At the same time, each paragraph should contain a separate logically complete conclusion or recommendation.

Based on the conclusions obtained, recommendations can be provided in the work. Recommendations are posted on a new page. The recommendations define the necessary, in the author's opinion, further research of the problem; submit proposals for the effective use of research results.

References.

Each source included in the list should be indicated in the text of the dissertation. The bibliographic description of the sources is compiled taking into account DSTU 8302:2015 "Information and documentation. Bibliographic reference. General Provisions and Rules of Drafting" [4].

Appendices (if necessary).

It is advisable to include in the appendices the supporting material necessary for the completeness of the perception of the dissertation:

- armchairs;
- additional illustrations or tables;
- materials that cannot be included in the main body due to the large volume or form of presentation (photographs, intermediate mathematical proofs, calculations, test reports);
- copies of terms of reference, contracts and work program;
- description of algorithms and listings of programs developed in the process of performing the dissertation;
- description of new equipment and devices used during the experiment;
- instructions and methods;
- copies of documents, separate excerpts from regulations (instructions), etc.

1.5. Scientific supervisor of the master's thesis

Scientific supervisor of the master's thesis:

- develops the topic of the qualification work, submits it for approval to the meeting of the department, and after the publication of the topic, gives the student the necessary explanations on the proposed topic; prepares and issues assignments for the master's thesis to the student within the time limits specified in the form given in Appendix B;

- gives recommendations to the student on the processing of the necessary literature, normative and reference materials, scientific publications, etc., on the topic of the master's dissertation;

- supervises the implementation of the work schedule. In case of significant violations, which may lead to the failure of the established deadlines for the provision of qualification work to the EC, informs the management of the department to take appropriate measures, including the decision not to admit to the defense;

- carries out general management of the student's performance of qualification work and is responsible for the presence of systemic errors in the work;

- in case of non-fulfillment by the student of his/her recommendations for correcting such errors, he/she shall indicate this in the review;

- uses the time allotted for management for: systematic (at least once every two weeks) interviews, at which the student informs about the status of work; possible solutions are discussed; individual points of the task are specified, etc.;

- consultations of the student on all issues related to the performance of work;

- verification of the work performed (in parts or as a whole);

- prepares a review with a description of the student's activities during the performance of qualification work and is responsible for its objectivity;

- prepares the student for the defense, organizes (if necessary) the preliminary defense;

- As a rule, he must be present at the meeting of the EC during the defense of qualification works, the scientific supervisor of which he is.

The review is made in any form, indicating:

- the relevance of the topic, in the interests or at the request of which organization it was performed (within the framework of the research work of the department, enterprise,

research institute, etc.);

- compliance of the work performed with the issued task;

- the level of disclosure of certain issues of work and the degree of independence in the performance of work;

- level of theoretical and practical training, knowledge of professional literature, student's preparedness for modern decision-making;

- ability to analyze the necessary literary sources, make sound (engineering, scientific) decisions, apply modern system and information technologies, conduct physical or mathematical modeling, process and analyze the results of the experiment;

- the most important theoretical and practical results, their approbation (participation in conferences, seminars, registration of patents, publication in scientific journals, etc.);

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

In the review, the supervisor does not evaluate the completed master's thesis on any scale.

1.6. Consultant on a separate section of the master's thesis

Master's Thesis Consultant

- draws up a schedule of consultations indicating the time and place of their conduct, coordinates it with the supervisor of the qualification work and brings it to the attention of students;

- sets, within his/her competence, tasks for the student, achieving a clear understanding of the ways to solve them;

- recommends methods for resolving issues, leaving the student the right to make the final decision;

- informs the supervisor of the qualification work about the state of implementation of the section, the persistence and independence of the student's work on the section, his attitude to the implementation of recommendations and taking into account the comments of the consultant;

- checks the section in a timely manner and, in the absence of comments, signs the title

page of the explanatory note and the relevant graphic (illustrative) material.

The Department of automation of electrical and mechatronic complex provides a consultant on “start-up project” part of master’s thesis.

1.7. Compliance Controller

He is appointed from among the scientific and pedagogical staff of the department, who have experience in supervising master's theses and are aware in detail of the requirements of state standards for their implementation and execution.

Informs the supervisors of master's dissertations about the requirements of state standards.

Advises graduates on the implementation and design of master's theses in accordance with the requirements of state standards.

Checks for compliance with the requirements of state standards fully completed and prepared for review and defense master's dissertations and, in the absence of violations of state standards, certifies the specified compliance with his signature on the title page of the explanatory note.

1.8. Master's Thesis Reviewer

The reviewer gets acquainted in detail with the content of the explanatory note and the illustrative material of the master's thesis, paying attention to the scientific level of development, the modernity and rationality of the decisions made, the correctness of calculations, the use of the latest technologies, compliance with the requirements of state standards, etc. If necessary, he/she receives an explanation from the master's student about the essence of the work.

Prepares a review in any form covering the following issues:

– relevance of the topic;

– compliance of the content of the qualification work with the approved topic and task;

– completeness of the task, correctness and depth of justification of the decisions made;

– novelty and quality of the research;

– the degree of use of modern achievements of science, technology, information and engineering technologies;

– correctness of calculations and design and technological solutions;

– presence andFullness experimental (physical or mathematical) confirmation of the decisions made;

– the reality of the dissertation, the possibility of implementing its results;

– the quality of the explanatory note and illustrative material, compliance with the requirements of state standards;

– identified deficiencies;

– motivated assessment of the master's thesis on a 100-point and university scale (for example, 90 / Very good***)*** in accordance with the Regulations on current, calendar and semester control of learning outcomes at Igor Sikorsky Kyiv Polytechnic Institute. Igor Sikorsky [5], as well as a conclusion on the possibility of awarding a graduate a master's degree in electric power engineering, electrical engineering and electromechanics.

The review should not duplicate the supervisor's review, because the supervisor's review is mainly a characteristic of the professional and personal qualities of the graduate, demonstrated by him in the process of completing the master's thesis, and the review is a characteristic of the quality of the qualification work itself; their complete coincidence will indicate a formal approach to peer review and should not remain without consequences on the part of the department (Appendix D). A negative assessment of the reviewer on a 100-point and university scale is not a reason for rejecting the master's thesis from defense.

1.9. Graduate

The graduate has the right to:

– choose the topic of the master's thesis from the list of topics proposed by the graduating department and approved by the order of the university, or offer their own with a motivated justification of the expediency and possibility of its implementation; in case of justified need, may initiate the issue of clarifying the topic of the master's dissertation, but *no later than before the scheduled start of the attestation work;*

– after the defense of the practice report, clarify, if necessary, with the supervisor certain provisions of the task for the performance of work, find out the content, features and requirements for the processing of specific issues, taking into account the complexity of the sections of the explanatory note and illustrative material, as well as the time for their verification by the manager, consultants and regulatory controller, obtaining the manager's feedback and reviews and preparing your report at the EC meeting;

– get a separate workplace for the master's dissertation, equipped with computer equipment, necessary equipment, reference literature, standards, samples of fragments of the explanatory note and graphic material, methodological instructions and recommendations for the implementation and design of the components of the master's dissertation, etc.;

– use the information materials of the department, devices, measuring equipment, etc., to conduct scientific research on the topic of scientific work;

– receive consultations from the manager and consultants in accordance with the approved schedule;

– independently choose options for solving problems on the topic of the master's dissertation;

– contact the management of the graduating department, institute, university and the chairman of the EC on certification issues.

The graduate is obliged to:

– choose the topic of the master's thesis in a timely manner and receive specific tasks from the supervisor regarding the processing of materials necessary for its implementation during the internship;

– during the internship, get acquainted with the practical implementation of issues of organization and management of production (enterprise, firm, etc.), technical, economic and other issues through the prism of the topic of the master's dissertation;

– independently perform the tasks of the master's dissertation, adhering to the calendar schedule, timely and adequately respond to the comments and recommendations of the supervisor and consultants;

– regularly, at least twice a month, inform the supervisor about the status of the dissertation in accordance with the schedule, provide the necessary materials for verification

at his request;

– when working on issues, take into account modern achievements of science and technology, use advanced methods of scientific and experimental research, modern computer information technologies, make optimal decisions based on a systematic approach;

– be responsible for the correctness of the decisions, justifications, calculations, the quality of the explanatory note and graphic (illustrative) material, their compliance with the methodological recommendations and instructions of the graduating department, existing regulatory documents and state standards;

– submit the master's thesis for verification to the supervisor, consultants and the regulatory controller within the established period and, after eliminating their comments, return it to the supervisor for his feedback;

– submit a master's thesis for checking for academic plagiarism within the prescribed period. The procedure for the implementation of measures to check for academic plagiarism is determined by the Regulations on the system for the prevention of academic plagiarism in Igor Sikorsky Kyiv Polytechnic Institute. Igor Sikorsky [6];

– obtain all the necessary signatures on the title page of the explanatory note and drawings and, together with the supervisor, submit to the head of the graduating department the master's thesis checked by the supervisor, consultants and the regulatory controller for preliminary consideration (pre-defense) in order to make a decision on admission to the defense;

- after successful completion of the preliminary review (pre-defense) of the master's dissertation, receive a resolution of the head of the graduating department on admission to the defense, referral for reviews and personally submit all the materials of the master's thesis to the reviewer, providing him, if necessary, with explanations of the essence of the work;

– get acquainted with the content of the supervisor's review and reviews and prepare (if necessary) reasoned answers to their comments when defending the master's thesis in the EC, moreover, it is forbidden to make any changes or corrections to the dissertation after receiving the supervisor's feedback and reviews;

– submit a master's thesis to the EC no later than one day before the attestation;

– to arrive in time for the defense of the master's thesis, and in case of

impossibility – to warn the head of the graduating department and the chairman of the EC (through the secretary of the EC) about his absence, indicating the reasons and then providing documents certifying the validity of the reasons for the absence.

The procedure for certification of graduates of higher educational institutions is regulated by the norms of the current legislation and is reflected in the Regulations [1].

2. PURPOSE AND OBJECTIVES OF THE MASTER'S THESIS

2.1. Purpose of the master's thesis

The master's thesis is a qualification work in the specialty 141 – Electric power engineering, electrical engineering and electromechanics under the educational and professional program "Engineering of intelligent electrical and mechatronic complexes", its content should reveal the author's competencies that are specified in the relevant educational program and be related to the solution of specific scientific or applied problems due to the specifics of the specialty.

Subject to the implementation of the curriculum in accordance with the educational program (https://osvita.kpi.ua/141_ONPM_IIETMK [in Ukrainian]), the applicant have to obtain the following program competencies:

In the process of preparing and defending a dissertation, a master's student must demonstrate:

- ability to search, process and analyze information from various sources,
- ability to use information and communication technologies,
- ability to apply knowledge in practical situations,
- ability to identify and assess risks,
- ability to communicate with representatives of other professional groups at different levels,
- ability to apply existing and develop new methods, techniques, technologies and procedures to solve engineering problems of electric power engineering, electrical engineering and electromechanics,
- ability to develop and implement measures to improve reliability, efficiency and safety in the design and operation of equipment and facilities of electric power, electrical engineering and electromechanics,
- ability to analyze technical and economic indicators and expertise of design solutions in the field of electric power, electrical engineering and electromechanics,

- ability to demonstrate knowledge and understanding of mathematical principles and methods necessary for use in the electric power industry, electrical engineering and electromechanics,

- ability to understand and take into account social, environmental, ethical, economic and commercial considerations affecting the implementation of technical solutions in the electric power, electrical engineering and electromechanics industries,

- ability to manage projects and evaluate their results,

- ability to develop plans and projects to ensure the achievement of a specific goal, taking into account all aspects of the problem to be solved, including the production, operation, maintenance and disposal of equipment of electric power, electrical and electromechanical complexes,

- ability to demonstrate awareness and ability to use regulations, norms, rules and standards in the electric power industry, electrical engineering and electromechanics,

- ability to use software for computer modeling, computer-aided design, computer-aided production and computer-aided development or design of elements of electric power, electrotechnical and electromechanical systems,

- ability to demonstrate knowledge of intellectual property and contract issues in the electric power, electrical engineering and electromechanics industries,

- ability to formulate technical requirements for developed products and technologies, determine the technical conditions for the operation and maintenance of new equipment, draw up technical specifications for research and development, identify key technological parameters of developments and determine their target or normative values in the field of engineering,

- ability to develop means, ways and methods of science and technology aimed at automation of existing and creation of new automated and automatic technologies and productions,

- ability to optimize technological processes and build structural diagrams of intelligent automated control systems.

Upon completion of the course of study, in accordance with the requirements of the educational program, the applicant must acquire the following program learning outcomes:

- reproduce processes in electric power, electrotechnical and electromechanical systems in their computer modeling,
- outline an action plan to improve the reliability, operational safety and service life extension of electric power, electrical and electromechanical equipment and related complexes and systems,
- analyze processes in electric power, electrical and electromechanical equipment and related complexes and systems,
- master the methods of mathematical and physical modeling of objects and processes in electric power, electrotechnical and electromechanical systems,
- search for sources of resource support for additional training, scientific and innovative activities,
- plan and implement research and innovative projects in the field of electric power, electrical engineering and electromechanics,
- take into account the legal and economic aspects of research and innovation,
- adhere to the principles and directions of the strategy for the development of Ukraine's energy security,
- communicate freely orally and in writing in the state and foreign languages on modern scientific and technical problems of electric power engineering, electrical engineering and electromechanics,
- demonstrate an understanding of regulations, norms, rules and standards in the field of electric power, electrical engineering and electromechanics,
- identify the main factors and technical problems that may hinder the implementation of modern methods of control of electric power, electrical and electromechanical systems,
- perform physical and mathematical modeling, static and dynamic analyses of structures, mechanisms, materials and processes at the design stage, investigate the reliability of systems, using modern computer tools,
- select the element base of electromechanical and mechatronic systems, complete electric and hydraulic drives, controls, protection, automation of power supply systems for machines and installations, production sites and enterprises,
- to create intellectually adaptive systems for automated control and monitoring of the

technical condition of electromechanical equipment based on the use of programmable logic controllers,

- calculate forces, stress-strain state, velocities, moments, powers, static and dynamic properties of electromechanical equipment, perform power and hydraulic calculations of hydraulic drive elements, electric drives, linear and nonlinear elements, electric and magnetic circuits.

A master's thesis is an independent research work that performs a qualification function, that is, it is prepared for the purpose of public defense and obtaining a master's degree.

2.2. Topics of master's theses

The master's student must choose the topic of the master's thesis from the list proposed by the department or suggest the topic independently from the materials obtained during the internship, and agree with the supervisor. There are four research groups at the department: Energy Efficiency Improvement System, Geomechatronic Systems of Resource-Saving Technologies, Adaptive Shock Wave Systems, as well as Chemical Reliability and Energy-Saving Technologies in Energy and transport and, as a rule, the topics of master's dissertations are focused on such topics. The topics of qualification works are considered and approved at a meeting of the Department of Automation of Electrical and Mechatronic Complexes and approved by the appropriate order and are not subject to correction.

A brief list of master's thesis topics:

1. Optimization of solar panel tracker system control with solar activity forecasting.
2. Fuzzy control of the electric drives of the pumping station for the irrigation system.
3. Vibration cavitation drill for drilling oil wells under the technological conditions of the Bugrivativske oil field.
4. Automation of medium-volume gas storage with integration of technological data into independent software complex.

5. Complex of electromechanical equipment and automation of the pumping unit of the water treatment system in Kyiv.

6. Robust control of elevator drive taking into account backlash of gearbox.

7. Electromechanical system of a double-motor hoisting unit in the conditions of the Stepova mine.

8. Electromechanical oil production system with several distributed sources of hydraulic and thermal energy.

9. Management of electric load of industrial enterprises using consumers-regulators.

10. Improvement of the electromechanical system of the concrete pump in the conditions of the subway section "Dorogozhichi - Syrets".

11. Improvement of electric drive control systems for radar equipment.

12. Optimization of control modes of the belt conveyor of a brick factory during emergency states of network operation.

13. Intelligent control system for high-speed elevator system of a public building.

14. Electromechanical equipment of the Lypovo-Dolinsky oil field with the development of a well vibration treatment system to increase its productivity.

Master's theses of other thematic orientation can also be carried out, which correspond to the profile of graduate training and are determined by the department on the initiative of students, supervisors or third-party organizations, including stakeholders.

The topics of master's theses have to be updated every year.

3. DEFENCE AND GRADING CRITERIA OF MASTER'S THESIS

3.1. Procedure for admission to the defense

Fully executed and signed by the master's student, supervisor and consultant, the master's thesis must be submitted to the graduating department no later than 2 weeks before the appointed deadline for defending the dissertation at the EC. The dissertation must be accompanied by the supervisor's review.

Preparation for the defense of the dissertation begins with the development of the presentation material of the dissertation and a scientific report based on the materials of the research.

The time of the speech (report, presentation) during the defense of the dissertation at the meeting of the EC should not exceed 15 minutes. The structure of the report and presentation should reflect the structure of the work and include a justification of the relevance of the research topic, the definition of a scientific problem, the formulation of the purpose and objectives of the study, a description of the methods used (solutions), disclosure of the main content of the research and developments, a brief analysis of the results obtained.

In the final part of the report and presentation, the most important results of the research obtained by the author should be given, their scientific novelty and practical significance should be noted, and recommendations for the application of the results should be provided.

When preparing a presentation (as a rule, a Power Point package is used), it is recommended to correlate the number and content of slides with the content of a scientific report. The slides should illustrate the main elements of the work done and the results obtained.

The slides should be titled: "Purpose and objectives...", "Comparative analysis ...", "Results of the study ..." Etc. The first slide should indicate the title of the master's thesis, its author, the number of the student group and the supervisor of the work. The last slide should contain the main conclusions, scientific results obtained by the author and developed recommendations.

The information saturation of each slide should not be excessive. Text, diagrams, drawings, graphs, drawings, photographs, and other illustrative material must be clear. As a rule, the total number of slides in a presentation should not exceed 20.

The graduating department conducts a pre-defense of the dissertation in order to pre-assess the quality and results of the research work performed and determine the degree of readiness of the master's student to defend the dissertation in the EC.

In the process of pre-defense at the department, the master student presents a presentation of the work done, makes a scientific report on the materials of the research, answers questions about the dissertation. The presence of a supervisor at the pre-defense is mandatory.

Based on the results of the pre-defense, the master's student, if necessary, can finalize and edit the text of his speech (report) and presentation materials, taking into account the comments made.

Based on the results of the pre-defense, the graduating department decides on the admission of the master's student to the defense of the master's thesis in the EC and sending the dissertation for review. Admission is confirmed by the visa of the head of the department on the title page of the qualification work.

Two reviews (one from an internal reviewer – an employee of another department, the second – from an external reviewer, the list of which is formed in advance by the graduating department) must be received and submitted to the graduating department no later than 1 week before the date of defense of the master's thesis in the EC.

Reviews are announced at the meeting of the EC during the discussion of the master's thesis. Receiving a negative review is not an obstacle to submitting a work for defense.

A master's student must be familiar with the reviews of his master's thesis before defending it at the EC meeting and has the right to give reasoned answers or objections to the remarks of reviewers in the process of defending the dissertation.

Qualification work, in which fundamental shortcomings in the decisions, justifications, calculations and conclusions, significant deviations from the requirements of the standards are revealed, are not allowed to be defended in the EC. The decision on this is made at a meeting of the graduating department, an extract from the minutes of which,

together with the official head of the department, are submitted to the director of the institute for the preparation of materials for the rector's order on the expulsion of the student.

3.2. Master's thesis defense

The defense of the final qualification work (master's dissertation) is part of the final state certification of master's graduates and is regulated by the Regulations [1].

The defense of master's theses is carried out at open public meetings of the EC with the participation of at least two-thirds of its members.

At the EC meeting, the master student is given time to present his dissertation and scientific report on the results of the research performed.

At the end of his/her report/presentation, the undergraduates answer questions from EC members and those present at the defense. In the final speech, the master student responds to the comments of reviewers and members of the EC. After the final speech of the master's student, the procedure for defending the master's thesis is considered completed.

The main task of the EC is to assess the scientific and professional knowledge and practical skills (competencies) of master's graduates on the basis of an examination of the content of the master's thesis and an assessment of the dissertator's ability to present and defend its main provisions.

The results of the master's thesis defense are determined on the basis of value judgments presented in the supervisor's review, reviews, comments of EC members about the main content of the work, the master's student's answers to the questions that were asked during the defense. The EC evaluates all stages of the dissertation defense - presentation and scientific report, understanding of questions and answers to them, the ability to conduct a scientific discussion, the general level of preparedness of the master's student, which are demonstrated during the defense.

The main criteria for evaluating a master's thesis are:

- the degree of compliance of the work with the level of qualification requirements for the preparation of masters, as well as the requirements for master's dissertations;
- relevance of the topic of the dissertation to the educational program of master's training, relevance, degree of disclosure of the topic;

- quality and independence of the research or development performed, including:

- substantiation of one's own approach to solving the research problem, independent choice and justification of the research methodology, originality and sufficiency of the sources used to assess the current state of the research problem, independence of the analysis of the material, development of the model, solutions, independent and scientifically based formulation of conclusions and recommendations based on the results of the study, completeness of the solution of the tasks set in the work;

- novelty and practical significance of the results obtained by the master's student, their reliability;

- language and style of writing the dissertation;

- compliance with the requirements for the design of a master's thesis.

Decisions on the results of the defense and grading are made at a closed meeting of the EC members by a simple majority of votes.

The grade received by the graduate during his certification in the EC is final and is not subject to appeal.

Upon successful defense of the master's dissertation, by the decision of the EC, the master's degree is awarded to the master's degree and a master's diploma (with an appendix) is issued. The EC may recommend publishing the results of the work done in periodicals scientific and technical publications, and a graduate of the master's degree program - before entering graduate school.

3.3. Master's Thesis Grading

According to the Regulations on the system of assessment of learning outcomes in Igor Sikorsky KPI [8] a rating system for evaluating the master's thesis is developed and approved by the graduating department, brought to the

applicants along with the internship program.

The rating grade for a master's thesis has two components.

The first component characterizes the quality of the student's work during the preparation of the master's thesis for defense.

The second component is determined by the examination commission during the meeting and takes into account the quality of the master's thesis and its defense.

The components of the rating score for the examination committee are determined by the following criteria:

Qualities of qualification work (maximum 60 points):

1. Practical orientation of the work and scientific novelty of the work

10 points – the work was performed at the request of the enterprise, institution. The terms of reference were approved by the customer of the study. The work uses original ideas that were put forward by the student personally (according to the supervisor's feedback). An in-depth analysis of scientific and technical results from the point of view of reliability, scientific and practical value is carried out.

8-9 points – the work was performed within the framework of economic contract or state order topics. The task is agreed with the customer of the topic. The research was carried out on the basis of well-known approaches, but at the same time the final solution to the problem that was posed was obtained. An assessment of the results obtained in the direction of the possibilities of their use in scientific and practical activities is carried out.

6-7 points – the work was done in the interests of the educational process of the department. Didactic requirements are approved by the head of the department. The work demonstrates the ability to carry out scientific research under supervision

and draw the right conclusions.

0 points – the work is not practical. The research was carried out on the basis of known approaches, but the final solution to the problem posed was not obtained.

2. Structure of the work. Substantiation of the research purpose and research method

10 points – the object, subject and relevance of the purpose of the research are reasonably determined. The analysis of the state of the problem is carried out according to the latest domestic and foreign sources. Patent research has been conducted. In-depth, according to many criteria, acceptable research methods are considered. The choice of theoretical and experimental research methods is carried out on the basis of approaches to system analysis.

8-9 points – the definition of the object, subject and relevance of the purpose of the research is not sufficiently substantiated. The analysis of the state of the problem was carried out mainly on the basis of domestic sources without the use of periodicals scientific and technical publications. Patent research was carried out on domestic sources. Several possible theoretical and/or experimental research methods are considered. On the basis of one of the criteria, the best method was chosen.

6-7 points – definition of the object, subject and relevance of the purpose of the research is not sufficiently substantiated. The analysis of the state was carried out mainly on the basis of educational literature and outdated sources (more than 10 years). The choice of the research method was made on the basis of a qualitative comparison, at least two options.

0 points – the object, the subject of the study are not defined. The relevance of the purpose of the study is not sufficiently substantiated. The choice of research method was carried out without sufficient justification.

3. Depth of theoretical justification, research and modeling of objects. Experiment Execution Level

10 points – the mathematical method of solving research problems was reasonably chosen. Boundary and initial conditions are correctly defined. The

method of modeling is reasonably chosen. An analysis of the adequacy of the developed model has been carried out. An original experimental methodology has been developed or an experimental setup has been created. The research was carried out at the modern technical and methodological level. Estimation of measurement errors and comparative analysis of theoretical and experimental results were carried out.

8-9 points – the choice of the mathematical research method, the modeling method was made correctly, but without sufficient justification. The developed model is adequate to the object of research. The basic assumptions are correct, but not well-founded. The choice of the method of experimental research is sufficiently justified. The research was carried out at the modern technical and methodological level. Estimation of measurement errors and comparative analysis of theoretical and experimental results are carried out.

6-7 points – the choice of the mathematical research method, the modeling method is not justified. Some assumptions are incorrect or unfounded. The ability to perform high-quality experimental research has been demonstrated. An analysis of the results is carried out and conclusions are drawn. Or a practical test of the performance of the developed method, algorithm, program, etc., is carried out.

0 points – there is no theoretical justification for the study. The experiment (practical test) was not performed.

4. Level of use of information technology (for users)

10 points – the solution of the research tasks was carried out on the basis of the use of several modern programs (variations of CAD/CAM/CAE etc. software). The choice of programs is justified. The Internet was used to collect information in the field of research.

8-9 points – when solving research problems, at least one modern program or

a program developed independently by means of object-oriented programming is used. The use of information technology has made it possible to significantly raise the level of solving research problems.

6-7 points – information technology is used to perform basic calculations and at the level of use of office technologies.

0 points – information technology is not used to solve the main issues of work.

5. The quality of design of the work and illustrative material

10 points – the material is presented clearly and concisely; the design of the work fully complies with the current requirements. Text material, all illustrations and tables are made using text and graphic editors. The illustrative material in full, with high clarity, reveals the main provisions of the work submitted for defense. The material is made with the help of modern graphic packages in compliance with the requirements of regulatory documents.

8-9 points – the material is presented clearly, concisely, but there are stylistic errors. Text material, all illustrations and tables are made using text and graphic editors. The illustrative material in full, but with insufficient clarity, reveals the main points of the work. The material is made with the help of modern graphic packages, there are minor deviations from the requirements of regulatory documents.

6-7 points – unclear presentation of the material, there are grammatical errors. Registration in violation of the requirements of regulatory documents. Illustrative material does not fully and with insufficient clarity reveal the main provisions of the work

0 points – the structure and design of the work do not meet the requirements. Illustrative material does not reveal the main provisions of the work.

6. Approval of scientific work material

10 points – one of the conditions is met (documents, materials or their copies confirming the fulfillment are attached):

➢ a patent of Ukraine or a positive decision on an invention, industrial design, utility model has been obtained;

➢ the results of the work have been implemented or accepted for implementation in accordance with the relevant acts;

➢ several scientific articles have been published in scientific professional journals or several reports have been made at scientific conferences (national, international).

8-9 points – one of the conditions is met (documents, materials or copies thereof confirming the fulfillment are attached):

➢ an application for a patent of Ukraine for an invention, industrial design, utility model or industrial property object has been filed;

➢ an article has been published in a scientific professional journal;

➢ a report was made at a scientific conference (republican, international);

➢ The results of the work are accepted for use in the educational process according to the act.

6-7 points – one of the conditions is met (documents, materials or copies thereof confirming the fulfillments are attached):

➢ a certificate of rationalization proposal has been issued;

➢ a report was made at a city (university) scientific conference;

➢ published an article in a scientific journal, collection;

➢ the article has been accepted for publication in a scientific journal.

0 points – There is no implementation of the results.

Defense of the qualification work (maximum 40 points)

36-40 points – high level of quality of the report, full knowledge of the material, excellent justification of the decisions made. The student knows how to defend his opinion.

31-35 points – the level of quality of the answer is above average, minor gaps in the knowledge of the material are allowed. The student justifies the decisions made well and knows how to defend his opinion.

24-30 points is the average level of quality of the student's answer. He does not know the material well enough, the degree of justification of the decisions made, he is not good enough to defend his opinion.

0 points – low level of response quality. The student has a poor command of the material, does not justify the decisions made and does not know how to defend his opinion.

The sum of points scored for the first and second components have to be converted to the credit score in accordance with Table. 1.

Table 1 – Conversion of rating points to university scale grades

Applicant's rating assessment	University scale of assessments of the level of acquired competencies
95… 100	Excellent
85… 94	Very good
75… 84	Good
65… 74	Satisfactory
60… 64	Enough
Less than 60	Unsatisfactory
Failure to comply with the conditions of admission	Not allowed

The examination committee evaluates each master's thesis at a closed meeting.

The decision of the examination commission after the defense of qualification works is openly announced to applicants.

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APPENDIX A

National technical university of Ukraine
"Igor Sikorsky Kyiv polytechnic institute"
Educational and scientific institute of energy saving and energy management
Department of automation of electrical and mechatronic complexes

"As a manuscript"
UDC_____

The following persons were admitted to the defense:

Head of the Department

_____ First Name, LAST NAME

«___»_____20__

Master's thesis

for a master's degree

according to the educational and professional program "Engineering of intelligent electrical and mechatronic complexes**"**

specialty 141 "Electric power engineering, electrical Engineering and electromechanics"

on the topic: "Theme of master thesis according to order"

Performed by:
Student, group GA-XXmpi
First Name, LAST NAME _____

Supervisor:
Position, scientific degree, academic title,
First Name, LAST NAME _____

Consultant for «Section name»:
Position, scientific degree, academic title,
First Name, LAST NAME _____

Reviewer:
Position, scientific degree, academic title,
First Name, LAST NAME _____

Compliance controller:
Position, scientific degree, academic title,
First Name, LAST NAME _____

I certify that in this master's thesis there are no borrowings from the works of other authors without appropriate references.
Student _____

Kyiv – 20YY

APPENDIX B

National Technical University of Ukraine

"Igor Sikorsky Kyiv Polytechnic Institute"

Educational and Scientific Institute of Energy Saving and Energy Management

Department of Automation of Electrical and Mechatronic Complexes

Level of higher education – second (master's)

Specialty – 141 "Electric power engineering, electrical engineering and electromechanics"

Educational and professional program "Engineering of intelligent electrical and mechatronic complexes"

CONFIRMED

Head of the Department

_____ First Name, LAST NAME

«___»_____20__ p.

TASK

for a master's thesis for a student

First name, Last name

1. Dissertation topic "Topic", supervisor of the dissertation First name, Last name, scientific degree, academic title, approved by the order of the university from "___"_____ 20__ No_____

2. Deadline for submission of the student's dissertation _____

3. Object of study

4. Imprint

5. List of tasks that need to be developed

6. Approximate list of illustrative material

7. Indicative list of publications

8. Master thesis chapter consultants*

Section			Surname, initials and position of the consultant	Signature, date	
				Task accepting status	Task execution status

9. Assignment issuance date _____

Schedule

No.	Name of the stages of the master's thesis	Deadline for the stages of the master's thesis	Note

Student First name, LAST NAME

Supervisor First name, LAST NAME

* If consultants are identified. The supervisor of the master's thesis could not be appointed as a consultant.

APPENDIX B
Supervisor's review at qualification work

REVIEW
of supervisor at master's thesis
for a master's degree

which performed on the topic: _____

_____

Student _____
(last name, first name, patronymic)

Supervisor
Master's Thesis

(position, scientific degree, academic title)	(Signature)	(initials, surname)
_____	_____	_____

APPENDIX D

Review of the qualification work

Review

at master's thesis

for a **master's degree**

performed on the topic: _____

_____

_____

Student _____

(last name, first name, patronymic)

Reviewer

_____ _____ _____

(position, scientific degree, academic title) (Signature) (initials, surname)

Seal of the reviewer's institution, organization *(only for external reviewer)*