MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY

“KHARKIV POLYTECHNIC INSTITUTE”

METHODICAL INSTRUCTIONS

for the preparation of essays

on the course “Electrotechnical Materials”

for full-time and part-time students of the specialty G3 Electrical Engineering and G5 Electronics, Electronic Communications, Instrumentation and Radio Engineering

Approved by the Editorial and Publishing Council of the University, Protocol No.1 13.02.2025

Kharkiv

NTU "KhPI"

2025

Methodical instructions for preparing essays on the course "Electrotechnical Materials" for full-time and part-time students of the specialty G3 Electrical Engineering and G5 Electronics, Electronic Communications, Instrumentation and Radio Engineering. / compiled by Gontar Yu., Kiessaiev O. - Kh.: NTU "KhPI", 2025 - 14 p.

Compiled by: Yu. Gontar, O. Kiessaiev

Reviewer: associate prof. Yu. Mokh

Department of Electrical Insulation and Cable Engineering

INTRODUCTION

These methodological guidelines are intended for full-time and part-time students of the specialty G3 Electrical Engineering and G5 Electronics, Electronic Communications, Instrumentation and Radio Engineering. The purpose of learning the academic discipline "Electrotechnical Materials" is to form in students theoretical knowledge and practical skills regarding the properties, classification, methods of selection and application of electrical materials in the field of electrical power engineering, electrical engineering, electromechanics and electronics. Special attention is paid to the study of the physicochemical properties of materials, their influence on the operational characteristics of electrical devices, as well as the technologies for manufacturing and using electrical materials in modern industry.

1. GENERAL PROVISIONS

Essay – a brief summary of the content of a scientific work, article. The purpose of the essay is to convey the main content of a particular source or the main views on a certain problem based on materials from several sources.

Writing an essay is a step towards future scientific work, which aims to:

– activate students' creative activity;

– increase interest in the discipline " Electrotechnical Materials";

– expand students' knowledge of the discipline " Electrotechnical Materials".

Writing an essay in the discipline " Electrotechnical Materials" is one of the forms of student work. The essay should be an independent, completed work that reflects the applicant's scientific interests, his knowledge, skills, abilities and serves as a form of involving the author in the specifics of theoretical work. Despite the possible compilability, the essay should be a holistic and completed work with a structure that demonstrates the author's ability to consistently and logically present the content of the topic under study. Special attention should be paid to creative comprehension, interpretation, analysis and generalization of materials related to the properties, classification, manufacturing technologies and application of electrotechnical materials. The author must demonstrate the ability to solve problems that have scientific and practical significance. In the essay, the applicant is required to demonstrate knowledge of both classical and modern sources on the topic of research, as well as the ability to substantiate the main provisions of his work during defense or exams.

2. ESSAY STRUCTURE

It is advisable to begin work on the chosen topic by developing a preliminary plan for the essay. The plan is the logical basis of the essay. The preliminary plan for the essay must be agreed upon in consultation with the lecturer. Having a preliminary plan for the essay, the student turns to the bibliography. Library catalogs, reference literature, periodicals on a given topic, and Internet resources can provide significant assistance to the student. It is better to start studying literature on the chosen topic with general works and textbooks in order to find out the place occupied by this problem. Then it is necessary to turn to specialized literature on the topic and take several monographs as a basis. It is necessary to familiarize yourself with scientific articles in periodical literature, which can serve as the main sources of information. When analyzing the text, it is necessary to assess what material is appropriate to use in the essay.

In particular, it is necessary to pay attention to the following elements of the text:

– facts that must be reflected in the essay;

– new ideas and hypotheses, experimental data, qualitatively new phenomena, processes, etc. This group of elements is subject to maximum reflection in the essay; only text abbreviations without loss of information are permissible here;

– data that are not fundamentally new: traditional methods, well-known formulations, digital material. They are presented in the essay selectively, depending on the meaning and purpose of the essay, and can be presented in a generalized and annotated form;

– arguments, explanations, examples and other information of an explanatory and illustrative nature. As a rule, they are either not included in the essay, or are presented in an annotated form.

The structure of the essay includes the following elements:

– title page,

– table of contents,

– introduction,

– main part (chapters, paragraphs etc.),

– conclusions,

– list of sources used.

The introduction, main part and conclusions constitute the main structural part of the document. All other elements act as additional, but important components.

The title page contains the name of the ministry to which the educational institution is subordinate (Ministry of Education and Science of Ukraine); the name of the higher education institution (NTU "KhPI"); the name of the department where the work was performed; course, group, institute, surname, first name of the author; (see Appendix A).

The title page is not numbered.

After the title page, there is a **table of contents (plan)** (the sheet is not numbered), which contains the names of sections and paragraphs and indicates the pages (interval - 1.5).

A sample of the design of the table of contents of the essay is given in Appendix B.

An introduction of 1-2 pages is an important part of the essay. It justifies the relevance of the chosen topic, assesses the state of research on the scientific problem, formulates the goal and defines the tasks of the essay, and gives a brief general overview of the work.

Requirements for the content of the **main part** of the essay:

In terms of content, the essay can be an analytical review of the history of studying the issue (what new things have been introduced by this or that researcher) or its current state, a critical analysis of the scientific discussion (comparison of different approaches to solving a scientific problem), as well as in the form of a detailed review of a specific scientific work. The content of the essay must correspond to

its topic, purpose and objectives. It is necessary to consistently reveal all the issues provided for in the plan, justify, explain the main provisions, and support them with specific examples and facts.

The text of the main part of the work is divided into chapters, subchatpers, paragraphs etc. Chapters and subchapters of the work must have headings. Paragraphs and subchapters may have headings. Each paragraph and sub-section must contain complete information. The responsibility for the reliability of the information contained in the work lies with the performer.

For greater clarity, it is proposed to illustrate the main part of the material with tables, diagrams, graphs, charts and maps. Illustrative material must have a title.

Conclusions are an independent part of the essay, which should not simply retell the content of the work. They should highlight the following aspects:

- assess the degree of achievement of the goal and fulfillment of the tasks of the work;
- list and briefly characterize known scientific approaches to the researched problem, as well as highlight new aspects, debatable issues that are subject to further study;
- determine what is valuable in the essayed works, what requires additional analysis and clarification, and what raises doubts.

The volume of conclusions is 1-2 pages.

3. ESSAY DESIGN

The essay must be printed on a standard A4 sheet of paper in compliance with the following requirements: margins: left – 30 mm, right – 15 mm, top – 20 mm, bottom – 20 mm; Times New Roman font size 14 pt; line spacing – 1.5; paragraph indentation – 1.25; text alignment – width.

The volume of the essay text – 15-20 printed pages.

Each structural element of the work's content begins on a new page. The names of structural elements must be placed in the center of the line without a dot at the end, without underlining, separated from the text by a line spacing. Hyphenation in words is not used. Figures and tables must have headings and numbering consistent with the section number. References in the text of the essay to sources should be indicated by a sequential number in the list of references, separated by two square brackets, for example: "… in the work of K.O. Petrenko [1, p. 27] it is determined …". Page references are also possible. Citations should be minimized and used only when they are truly necessary.

When writing a paper, you should refer to sources, materials, individual results or ideas and conclusions that are used in the paper when considering the problem. Such references allow you to find documents, check the reliability of information about citing a document, provide the necessary information about it, help to clarify its content, language of the text, and scope.

References in the text of the paper to sources should be indicated by a sequential number in the list of references, separated by two square brackets, for example, "… in the works [1-7]".

The list of used sources should be placed in the order of appearance of the references in the text.

The main requirement for compiling a list of sources used is a uniform design and compliance with the current state standard for bibliographic description of printed and electronic publications. Appendices are placed at the end of the work, if necessary. It is recommended to include materials in the appendices that are necessary for the completeness of the work and related to its implementation and for some reason cannot be placed in the main part. All appendices must be referenced in the text.

The appendix should begin on a new page and with the word "Appendix", which should be written at the top on the right side of the line. Its designation should be indicated through a space. Appendices

should be indicated sequentially in capital letters of the Ukrainian alphabet, for example, Appendix A, Appendix B, etc.

The following may be included in the appendices:

1) materials that supplement the essay;

2) tables of auxiliary digital data;

3) illustrations of an auxiliary nature;

4) other documents.

The work is stapled into a folder. In the case of distance learning, the work is sent to the lecturer by corporate mail.

4. ESSAY TOPICS

The student can choose an essay topic from the list of proposed ones or propose his own, which corresponds to the subject of the discipline and arouses his personal interest. In case of choosing his own topic, it must be agreed with the lecturer.

Suggested topics:

1. Conducting materials in electrical engineering: properties and applications.
2. Polymer insulating materials: types and features of use.
3. Composite materials in electrical engineering: modern solutions.
4. Supercapacitors: materials and development prospects.
5. Magnetic materials for transformers: classification and characteristics.
6. High-temperature superconductors: applications in energy.
7. Conducting polymers in modern electronics.
8. Graphene and its applications in electronics and electrical engineering.
9. Features of the selection of materials for high-voltage insulators.
10. Materials for cable sheaths: properties and durability.
11. Thermally conductive materials for cooling electronic components.

12. Dielectrics in capacitors: modern materials and their characteristics.

13. Use of semiconductor materials in power electronics.

14. Nanomaterials in electrical engineering: properties and applications.

15. Permanent magnets based on rare earth materials.

16. Biodegradable materials for electrical engineering: prospects for implementation.

17. Piezoelectric materials: properties and use in sensors.

18. Features of the choice of materials for AC electric machines.

19. Technologies for the production of copper and aluminum conductors.

20. Features of the manufacture and use of insulating varnishes.

21. Ferromagnetic materials: basic properties and applications.

22. Use of nanotechnologies in the production of electrical materials.

23. Materials for photovoltaic elements: characteristics and applications.

24. Features of the use of polymers in printed circuit boards.

25. Protective coatings for electrical equipment.

26. Materials for current-collecting contacts: selection and influence of operating conditions.

27. Ceramic materials in electrical engineering: advantages and disadvantages.

28. High-strength materials for DC motors.

29. Anti-corrosion materials for electrical structures.

30. Modern insulating materials for high-voltage equipment.

31. Use of optical materials in communication systems.

32. Effect of temperature on the characteristics of electrical materials.

33. Carbon materials for electrodes in energy sources.

34. Application of dielectric materials in microelectronics.

35. Technologies for the production of materials for X-ray detectors.

5. RECOMMENDED LITERATURE

1. O. Milton. Engineering materials science. 1995 – 827 p.
2. Advanced Magnetic Materials/Edit. by L Malkinski - Rijeka: InTech, 2012. - 230 p.
3. Properties of Materials for Electrical Engineers / J. W. Nilsson, S. Riedel. - Pearson, 2020.
4. Electrical Engineering Materials / A.J. Dekker. – Prentice Hall, 2017.
5. Engineering analysis of smart material system / Donald J. Leo, Department of Mechanical Engineering Virginia Polytechnic Institute and State University, 2007. – 569 p.
6. Smart materials and structures / Bo-Hua Sun. Lecture at the Swiss Federal Institute of Technology Zürich (ETH) Zürich, 2015. – 101 p.
7. Lu, F. Modeling and analysis of micro piezoelectric power generators for micro-electromechanical-systems applications. / F Lu, Lee H.P., Lim, S.P. // Smart Materials and Structures, № 13, 2004, pp. 57-63.
8. Nanoelectronics and information technology. Advanced electronic materials and novel devices, 2003. – 1001 p.

Appendix A

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY

"KHARKIV POLYTECHNIC INSTITUTE"

Educational and Scientific Institute of Power Engineering, Electronics and Electromechanics

Department of Electrical Insulation and Cable Engineering

TOPIC TITLE

Essay on the discipline " Electrotechnical Materials"

Completed by

student __ course ____group

_____
Surname, first name

Checked by

_____

202_

Appendix B

Sample of the essay table of contents

Educational edition

Methodical instructions for the preparation of essays from the course "Electrotechnical Materials" for full-time and part-time students of the G3 Electrical Engineering and G5 Electronics, Electronic Communications, Instrumentation and Radio Engineering majors

Compilers: Yuliia GONTAR, Oleksandr KIESSAIEV

Responsible for the release Assoc. Prof. Oleksandr KIESSAIEV

The work was recommended for publication by Prof. Hanna BEZPROZVANNYKH

In the author's edition

Plan 2025, pos. 11

Submitted for printing_____Times New Roman font.

Publishing center of NTU "KhPI",

2 Kyrpichova st., Kharkiv, 61002

Certificate of state registration of the State Educational Service No. 5478 dated 08/21/2017

Electronic version