

**Vinnitsia National Technical University**  
**Department of Power Plants and Systems**  
**Faculty of Power Engineering and Electromechanics**

**METHODOLOGY AND ORGANIZATION OF SCIENTIFIC RESEARCH  
IN ELECTRICAL ENERGY, ELECTRICAL ENGINEERING AND  
ELECTROMECHANICS**

**Compulsory  
Professional**

**Master's level** of higher education

**Educational program:** Power plant

**Specialty:** 141 – electrical engineering and electromechanics

**Lecturer:** Valentine GRABKO

ECTS credits – 4 (120 hours)

Lectures – 27 hours

Practical lessons – 18 hours

Self-support work – 75 hours

The course is given in **English**

**Course content**

Prerequisites for study: the discipline "Methodology and organization of scientific research in electric power, electrical engineering and electromechanics" is based on the study of the processes of obtaining and processing scientific information. This discipline is directly related to and complements such basic disciplines as "Fundamentals of research work", "Modern problems of electric power, electrical engineering and electromechanics", "Mathematical problems of energy".

The purpose of studying the academic discipline is to master the organizational support of scientific research and to learn how to conduct scientific research in the field of electrical power, electrical engineering and electromechanical topics.

**The main tasks** of studying the discipline are

- get acquainted with the main methods and means of conducting scientific research
- familiarize yourself with the methods and normative documents used during the analysis of the obtained scientific data.

**Competencies that the applicant must master as a result of studying the discipline**

The study of an academic discipline involves the formation and development of students' competencies:

**Integral:** The ability to solve complex problems and tasks during professional activity in the field of electric power, electrical engineering and electromechanics or in the learning process, which involves conducting research and/or implementing innovations and is characterized by the uncertainty of conditions and requirements.

**General:**

GC01. Ability to abstract thinking, analysis and synthesis, personal and professional development.

GC02. Ability to search, process and analyze information from various sources, as well as possess critical thinking skills.

GC05. The ability to use a foreign language to carry out scientific and technical activities.

### **Special (professional):**

SC01. The ability to apply specialized conceptual knowledge, including modern scientific achievements in the field of electric power and electrical engineering to solve scientific and technical problems and tasks.

SC02. The ability to apply existing and develop new methods, techniques, technologies and procedures for solving engineering tasks of electric power and electrical engineering.

SC03. The ability to plan, organize and conduct scientific research, as well as clear and unambiguous communication of own knowledge, conclusions and arguments to specialists and non-specialists in the field of electric power and electrical engineering, in particular to students.

SC07. Ability to demonstrate awareness of intellectual property issues, management of work or learning processes that are complex, unpredictable and require new strategic approaches in electric power.

SC12. The ability to develop plans and projects to ensure the achievement of a specific goal, considering all aspects of the problem being solved, including production, operation, maintenance and disposal of equipment of electric power systems.

SC15. The ability to publish the results of their research in specialized scientific publications.

SC16. The ability to solve complex specialized tasks and practical problems related to the operation of information systems in electric power engineering, electrical engineering and electromechanics.

## **Program of academic discipline**

### **Content module 1. Basic provisions and basic concepts of scientific research methodology**

**Topic 1.** Introduction. List of recommended literature for study. Purpose and tasks of the discipline, basic definitions.

**Topic 2.** The essence of scientific research, its types and stages. Definition of science, its significance for humanity. Classification of sciences. The purpose, object, subject and methodology of scientific research. The essence of scientific research, types of scientific research, stages of scientific research. Methods and methodology. Concept of scientific method. Method, methodology, technique, technique. Multilevel methodology of science. General scientific methodological principles and their change during the development of science.

**Topic 3.** Methods of empirical and theoretical research, structure of empirical and theoretical knowledge. General scientific and special, empirical and theoretical, quantitative and qualitative methods. Structure of empirical and theoretical knowledge.

**Topic 4.** Selection of the topic of scientific research and justification of its feasibility. General characteristics of the problems of scientific research. Selection of the topic of scientific research within the framework of available issues. Information search. Justification

of the expediency of conducting scientific research on the selected topic. Formulation of scientific research tasks on the selected topic.

**Topic 5.** A systematic approach to the construction of scientific research methodology. General characteristics of the system approach. Examples of the application of system analysis at various stages of scientific research in the field of electric power and electro-mechanics.

**Content module 2. Writing articles, writing patents, grant applications, project applications, motivational and recommendation letters, fundraising and crowdfunding.**

**Topic 6.** Writing articles. Choosing a topic. The structure of a scientific article of a technical direction.

**Topic 7.** Patent. Utility model patent. Patent for the invention. Certificate of the work.

**Topic 8.** Writing a grant application. Search for grants. Analysis of successful cases of implementation of projects supported by grantors. Writing an application. Planning activities. Financial plan. Start-up

**Topic 9.** Receiving personal grants. Platforms for searching for personal grants. Compilation of CV. Writing a letter of recommendation and motivation.

**Topic 10.** Fundraising and crowdfunding. Existing tools.

**Topics of practical classes**

№	Topic name
1	Purpose and tasks of the discipline, basic definitions. General information about modern design
2	General scientific methodological principles and their change during the development of science.
3	Structure of empirical and theoretical knowledge. Formulation of scientific research tasks on the selected topic.
4	Structure of a scientific article of a technical direction.
5	Utility model patent.
6	Search for grants.
7	Compilation of CV.
8	Fundraising for the implementation of projects in microgrids, LES, REM, creation of energy communities (energy cooperatives)
9	Crowdfunding.

**Independent work**

№	Topic name
1	Develop a list of recommended literature for study. The choice of the method of solving the problem of optimization of the electrical subsystem.
2	Method, methodology, technique, technique.
3	Structure of empirical and theoretical knowledge.
4	Formulation of the tasks of scientific research on the selected topic.
5	Examples of the application of system analysis at various stages of scientific research in the field of electric power and electromechanics.
6	Selection of the topic of a scientific article and publication.
7	Certificate of the work.

8	Planning of activities. Financial plan. Start-up
9	Platforms for searching for personal grants.
10	Fundraising and crowdfunding.

### Individual tasks

According to the decision of the department, students prepare essays on individual topics of the discipline and reports for the annual scientific and theoretical meetings of VNTU divisions.

### Teaching methods

The main teaching methods are: lecture-visualization; story-explanation; briefing; illustrating; demonstration, in particular, using multimedia learning tools; oral survey; testing; educational discussion; conversation-dialogue; performance of laboratory work; group work; a report on topics assigned to independent study; solution of practical tasks; consultations; independent work at home; individual tasks (abstracts, essays, etc.), preparation of reports of a research nature, in particular, for the annual scientific and technical conference of VNTU units.

### Control methods

Current control, which is carried out in the form of frontal, individual or combined control of students' knowledge during lectures, practical classes, testing, colloquiums, defense of course project, exam. The examination may be conducted by means of an oral examination and/or tests.

### Distribution of points received by students

Table 1 – Distribution of points for mastering content modules during the semester for full-time students

Current testing and independent work									Sum
Content module 1				Content module 2					
T1	T2	T3	T4	T5	T6	T7	T8 – T10	Final test	100
50 points				25 points				25 points	points

T1, T2 ... T10 – topics of sections included in content modules.

Table 2 – Evaluation of students' knowledge, abilities and skills in certain types of work and in general by modules (in points)

Type of work	Module 1	Module 2	Total
1. Practical lessons (1 practical lesson – 2 points)	14	12	26
2. Colloquium	16	8	24
3. Control work	15		15
4. Final test		25	25
5. Abstract	5	5	10
Total	50	50	100

### Course policy

Applicants and teachers must adhere to the norms of ensuring honor, dignity, mutual respect and trust, equality and tolerance of all participants in the educational process by

observing the principles of academic integrity set forth in the "Regulations on Academic Integrity at VNTU".

**In order to prevent and detect plagiarism in academic works, to develop the skills of correct work with sources of information and to implement the practice of proper citation, compliance with the requirements of scientific ethics and respect for intellectual property, and activation of independence and individuality when creating an author's work and responsibility for violations of generally accepted rules of citation should be observed of norms "Regulations on the prevention of academic plagiarism and the procedure for its detection in educational, scientific, qualification and scientific-methodological works at VNTU".**

In order to recognize the learning results obtained during non-formal and/or informal education (which was obtained according to educational programs and did not involve the awarding of staterecognized educational qualifications by education level, but could end with the awarding of professional and/or partial educational qualifications, as well as education that was carried out in the manner of self-education), applicants can use the relevant procedures specified in the **"Regulations on the procedure for recognizing learning results obtained through informal and/or informal education at VNTU"**.

Applicants have the right to appeal the results of intermediate and final control measures, but only on the basis of reasoned explanations, in accordance with the **"Procedure for the organization and conduct of assessments, differentiated assessments, examinations at VNTU"**, as well as by directly contacting the educational ombudsman, according to the **"Regulations on the educational ombudsman on the rights of VNTU students"**.

In order to resolve conflict situations that may arise between applicants and other participants of the educational process and/or to prevent the occurrence of conflict situations, one should be familiar with the norms of the **"Code of Ethics of VNTU"**.

VNTU applicants must be guided by the principle of "zero tolerance" to any manifestations of corruption and must take all measures provided by law to prevent, detect and counter corruption and related actions (practices), in accordance with the VNTU Anti-Corruption Program.

These documents are published on the VNTU website: <https://vntu.edu.ua/uk/publicinfo/zag.html>.

### **Recommended literature**

1. Петрук В.Г., Володарський Є.Т., Мокін В.Б. Основи науково-дослідної роботи. Навчальний посібник / Під ред. Петрука В.Г. – Вінниця: УНІВЕРСУМ-Вінниця, 2005. – 144 с.
2. Семенюк Е.П., Мельник В.П. Філософія сучасної науки і техніки. – Львів: Світ. 2006. – 152 с.
3. Шейко В.О., Кушнаренко М.В. Організація та методика науково-дослідної роботи. - Київ: Техніка. 2002. - 362 с.
4. Основи наукових досліджень та технічної творчості: Навч. посібник / Журахівський А.В., Варецький Ю.О. Бахор З.М.; За редакцією І.В. Жежеленка. – Видавництво Приазовського Державного технічного університету, 2000. – 138 с.
5. Шидловський А.К., Стогній Б.С. та ін. Паливно-енергетичний комплекс України в контексті глобальних енергетичних перетворень. - Київ: Українські енциклопедичні знання, 2004. - 468 с.

6. Закон України про пріоритетні напрями розвитку науки і техніки N 2623- III від 11.07.2001 року // Відомості Верховної Ради (ВВР). – 2001. - № 48. - С. 253.
7. Закон України про електроенергетику №575/97-ВР від 16.10.1997.
8. Закон України про охорону прав на винаходи і корисні моделі N 1771-III від 1.06. 2000.
9. Лежнюк П.Д., Рубаненко О.Є., Лук'яненко Ю.В. Основи теорії планування експерименту. Лабораторний практикум. – Вінниця: ВНТУ, 2006. – 167 с.
10. Як підготувати і захистити дисертацію на здобуття наукового ступеня. Методичні поради / Л.А. Пономаренко. - К.: Толока, 2001. - 80 с.
11. Де і як публікувати результати дисертаційних досліджень. Збірник нормативних документів з питань атестації наукових працівників. / Ю.І. Цеков. - К.: Толока, 2003. - 128 с.
12. Кутін, В. М. Методологія та організація наукових досліджень в електроенергетиці, електротехніці та електромеханіці : електронний навчальний посібник комбінованого (локального та мережного) використання [Електронний ресурс]. / В. М. Кутін, М. В. Кутіна. – Вінниця : ВНТУ, 2023. – 112 с.