НАЦІОНАЛЬНА АКАДЕМІЯ НАУК УКРАЇНИ
ІНСТИТУТ СОРБЦІЇ ТА ПРОБЛЕМ ЕНДОЕКОЛОГІЇ НАН УКРАЇНИ

Затверджено
Вченою радою
Інституту сорбції та проблем
ендоекології НАН України
протокол №8
від « 18 » грудня 2023 р.

Голова Вченої ради
Інституту сорбції та проблем
ендоекології НАН України
чл.- кор. НАН України
_____ Володимир БРЕЙ

WORKING PROGRAM OF EDUCATIONAL DISCIPLINE

Modern principles of organizing and carrying out scientific research

Kyiv -2023

1. DESCRIPTION OF THE COURSE

<table>
<tr><td rowspan="2">Item</td><td rowspan="2">Field of knowledge, the direction of training, education and qualification level</td><td colspan="2">Course</td></tr>
<tr><td>Full-time education</td><td></td></tr>
<tr><td>Credit: 2</td><td>Field of knowledge
"Natural Sciences"
Specialty 102
"Chemistry"
(code and name)
Specialization
"Physical Chemistry"</td><td colspan="2">Optionally</td></tr>
<tr><td>Module:– 2</td><td rowspan="5"></td><td colspan="2">Years:</td></tr>
<tr><td></td><td>1st</td><td></td></tr>
<tr><td></td><td colspan="2">Semester</td></tr>
<tr><td>Hrs – 60</td><td>1st</td><td></td></tr>
<tr><td rowspan="6">Classroom work:
20 hrs
Individual work:
40 hr</td><td colspan="2">Lectures</td></tr>
<tr><td rowspan="5">Educational qualification level: PhD</td><td>11 hrs.</td><td></td></tr>
<tr><td colspan="2">Practical, seminar</td></tr>
<tr><td>9 hrs</td><td></td></tr>
<tr><td colspan="2">Individual</td></tr>
<tr><td>40 hrs.</td><td></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">Control type: exam</td></tr>
</table>

2. AIM AND SCOPES OF THE COURSE

The purpose of the course "**Modern principles of organizing and carrying out scientific research**" is to obtaining the theoretical knowledge of the methodology of scientific research and to acquire practical skills and abilities related to their organization and carrying out in the scientific specialty "Chemistry".

The main tasks of the course:

- ✓ to reveal the concept of scientific activity in a multifaceted manner;
- ✓ understand the processes of scientific activity;
- ✓ learn the apparatus of scientific activity;
- ✓ to be familiar with the basics of the methodology of scientific knowledge and the methodology of scientific research, as well as to be oriented in modern methodological concepts, in particular in the field of Chemistry;
- ✓ familiarize with the state of scientific activity in Ukraine and the world;
- ✓ familiarize with electronic and Internet information resources;
- ✓ familiarize with the capabilities of Clarivate resources and the SciVal analytical system;
- ✓ master the system of working with bibliographic sources of information;
- ✓ to study the order of registration of scientific research and optimization of the process of scientific knowledge.

As a result of studying the discipline, graduate students acquire the following competencies:

general skills (competencies):

- ✓ the ability to abstract thinking, critical analysis, evaluation of facts, synthesis of new ideas on the basis of established regularities in chemistry;
- ✓ the ability to learn and master modern knowledge and carrying out independent scientific research;
- ✓ to be able to systematize and rethink the acquired knowledge;
- ✓ the ability to work in a team, develop organizational skills and motivate colleagues to fruitful cooperation;
- ✓ the ability to search, process and analyze information from various sources;
- ✓ the ability to generate new ideas and the ability to implement their verification

special (professional) skills (competencies):

- ✓ the ability to present the results of one's own scientific research and carry out scientific discussions;
- ✓ the ability to plan and implement scientific projects, make proposals for funding scientific research, assess possible risks in conducting scientific research and ways to prevent them, optimize scientific activity.
- ✓ justify the advantages of scientific or scientific and technical products in comparison with existing analogues.

As a result of mastering the course, the postgraduate student must demonstrate knowledge, skills and abilities corresponding to the thematic modules of the discipline, and apply them in further studies and work on the dissertation:

To know:

- ✓ basics of the methodology of scientific knowledge;
- ✓ concepts and models of science development;
- ✓ state of scientific activity in Ukraine and abroad in the field of activity of a postgraduate student;
- ✓ logic of the scientific research process;
- ✓ main categories of scientific and cognitive activity;
- ✓ methods and features of empirical and theoretical research and their interaction;
- ✓ methodological principles, structure, functions of scientific knowledge;
- ✓ peculiarities of the organization and carrying out of one's own scientific research;
- ✓ methodology of modern scientific research in the field of chemistry;
- ✓ main types and sources of scientific information;
- ✓ process of preparing a manuscript, its submission, review and publication in journals
- ✓ general requirements for registration of scientific research.

To be able:

- ✓ define and justify a scientific problem;
- ✓ describe the methodological apparatus of the research: the purpose and task of the research, formulate the problem, object, subject, hypothesis of the research;
- ✓ build the logic of scientific research;
- ✓ use the full-text platform ScienceDirect, Research4Life and scientometric databases;
- ✓ create personal ORCID ID, Researcher ID, Google Scholar profiles and organize them;
- ✓ search, analyze and process information from scientific sources related to scientific research;
- ✓ develop the methodology and plan of scientific research;
- ✓ process the results and carry out their approbation;
- ✓ build an effective publishing strategy by choosing relevant publications
- ✓ prepare the scientific text of the work for defense and defend it.

3. CURRICULUM OF THE COURSE

First module. CONCEPT OF SCIENCE.

Topic 1. Object, subject, content, tasks and structure of the course.

Object, subject and tasks of the course "Modern principles of organization and conduct of scientific research". Course structure. Definition of the term "science". The importance of science for society. Principles of the emergence and development of scientific knowledge. Priorities of scientific research. Functions of science. Classification of science. Fundamental and Applied Sciences. The essence and features of the formation and development of various types of sciences.

Topic 2. The essence and structure of scientific knowledge.

Terminological apparatus of science. The essence and structure of scientific knowledge. Theoretical knowledge and prerequisites for its emergence. The importance of theory for the development and organization of society. Empirical knowledge, its characteristics and differences from theoretical knowledge. The structure of empirical knowledge, its relationship with theory and practice. Concept of subject, object and subject of scientific knowledge, their features. Apparatus of science. The essence of a scientific term, category, concept, paradigm, law, regularity. Concept of axiom, hypothesis and scientific assumption.

Topic 3. Organization of the research process.

The essence of the research process. The structure of the research process. Formation of theoretical ideas about the nature of research. Determination of the level of study of the topic based on a literature review. Analysis and systematization of existing source data of scientific research. Possibilities of application and verification of data. Peculiarities of using general scientific and special methods of scientific research. Formulation of the purpose of scientific research. Development of scientific research methodology as a system of general and special methods. Analysis of the results of the application of the methodology and preparation of conclusions based on the results of scientific research. Development of recommendations for achieving the goal of scientific research. Types of works of a scientific nature: article, review, review, abstract, report. Approbation of the results of scientific research. Preparation

of abstracts and presentations at scientific conferences. Basic requirements for preparation and writing of scientific articles, abstracts, monographs.

Topic 4. Methodology and methods of scientific research.

Methodology of science. Concept of methodology, technique and research method. Levels of scientific methodology: their essence, significance and characteristic features. Concept of scientific research method. Classification of empirical and scientific methods. Comparative, historical, systematic approach. Structural analysis, statistical, logical, modeling, expert evaluations, etc. Connection of method and research methodology.

Topic 5. Organization of graduate student's work during scientific research.

Concept of scientific research process. Peculiarities of organization and execution of scientific research. Stages of scientific research. Study of the main factors, regularities and principles of organization. Stages of scientific work: analysis of literary sources; selection and understanding of the object and subject of research; organization of research work; obtaining new results; collection and systematization of scientific information; generalization and finding regularities; preparation of conclusions and recommendations. Peculiarities of organization and planning of individual and collective scientific activity. Drawing up a plan and schedule of scientific work.

Topic 6. Theoretical research

Tasks and structure of theoretical research. Modern methods of theoretical research. Application of mathematical apparatus and various computational approaches.

Topic 7. Experimental research

The essence of the experiment and its content. General requirements for performing the experiment. Classification. Methodology of experimental research planning. Approximation of results. Statistical processing. Regression analysis and the use of computer technologies to analyze, systematize and present the results of experimental researches.

Second module: SCIENTIFIC ACTIVITY AS A MEANS OF KNOWLEDGE

Topic 8. Scientific activity in Ukraine and its organization

Legislation of Ukraine on scientific activity. Requirements and procedure for training and certification of scientific personnel. The system of higher education in Ukraine. Academy of Sciences. Main types of research institutions. History and development of the National Academy of Sciences of Ukraine. Scientific degrees and scientific titles in Ukraine. Integration of Ukrainian science into the world. International cooperation. Scientific schools. Funds for promoting the development of science and technology, grants, international research programs and internships abroad.

Topic 9. Scientific research in chemistry

Methodological and theoretical basis of scientific research. Finding and substantiating and determining the relevance of a scientific problem. Scientific novelty. Choice of research methodology. Priority areas of scientific research in chemistry. Main directions of scientific activity of the Institute. Advanced trends in sorption science. Methods of synthesis and research of medical carbon sorbents and highly selective inorganic ionites, as well as catalysts for electron and proton transfer reactions. Research aimed at solving environmental problems.

Topic 10. Main directions of postgraduate research

Problem-thematic directions of postgraduate research in the specialty "chemistry" Connection of the subject of postgraduate research with the subject of the department. Sorption/sorption materials for environmental and medical purposes, Heterogeneous catalysis, Environmental chemistry. General and specific aspects of solving a scientific problem. Areas of related research. Experimental and theoretical studies. Practical application of the results.

Topic 11. Conducting of graduate student's research

Organization of scientific work of graduate students. Choosing a research topic. Drawing up a research plan. Analysis of the literature on the selected topic. Conducting research. Analysis of results and preparation of conclusions from the conducted scientific research. Development of recommendations for achieving the goal of scientific research and solving the tasks. Basic forms of implementation of the

results of scientific research. Peculiarities of approbation of scientific research results. Criteria for the effectiveness of scientific research. Preparation of theses of reports and speeches. Discussion as a form of approbation of scientific research. The procedure for conducting a scientific discussion. Defense of the dissertation.

Topic 12. Search, systematization of information in the course of scientific research

Peculiarities of searching, systematizing and using information on the Internet. Search servers. Working with abstract journals, systematic and alphabetical catalogs. Electronic Internet libraries. The safety of using Internet resources, the degree of their reliability, objectivity and informativeness. Links to Internet sources. Bibliographic sources of information in scientific research. Procedure for searching sources. The capabilities of Clarivate resources and the SciVal (Elsevier) analytical system for monitoring and analyzing international scientific research using various modules: Overview, Benchmarking, Collaboration, Reporting. Main trends in the field of digital and open science, open data, open access, changes in scientific communication. Full-text platforms ScienceDirect, Research4Life, Scopus databases. Formatting and systematization of bibliographic references. Peculiarities of compiling a list of literature when conducting scientific research (monographs, multi-volume publications, collections of scientific works, dictionaries, encyclopedias, deposited scientific works, journals, theses of reports, abstracts, dissertations, author's certificates, patents, catalogs, foreign publications).

Topic 13. Dissertation: requirements, order of preparation, and design

Choosing a topic. Drawing up a plan of the dissertation. Work on the dissertation. Study of literary sources. Methods of collecting factual materials and compiling a literature review. Verification of compliance of the dissertation materials with the established requirements. Dissertation manuscript preparation procedure. Rubrication of the text. Methods of presentation of scientific materials. The language and style of the dissertation. Basic requirements for the design, content and structure of the dissertation. Rules for submitting drawings, tables, formulas, and appendices. General rules of citation and references to used sources. Preparation of the list of used references.

Topic 14. Abstract: preparation and publication. Scientific publications

General requirements for the abstract. Completion of the abstract. Abstract. Publication of the abstract. Electronic version of the dissertation abstract. List of scientific works: functions, types, number and scope. Theses of the scientific report. The process of manuscript preparation, submission, review and publication in Elsevier journals; building an effective publication strategy, using a relevant publication, Scientific article. Scientific monograph.

4. DISTRIBUTION BY TYPES OF TRAININGS AND HOURS

Topics	Amount of hours				Individual work
	All	Classroom work			
		Total	Lectures	Practical	
First module. CONCEPT OF SCIENCE					
Topic 1. Object, subject, content, tasks and structure of the course			1	1	2
Topic 2. The essence and structure of scientific knowledge.					2
Topic 3. Organization of the research process.			1	1	2
Topic 4. Methodology and methods of scientific research			1	1	2
Topic 5. Organization of graduate student's work during scientific research			1		4
Topic 6. Theoretical research			1	1	4
Topic 7. Experimental research					4
Amount of hours in first module			**5**	**4**	**20**
Second module: SCIENTIFIC ACTIVITY AS A MEANS OF KNOWLEDGE					
Topic 8. Scientific activity in Ukraine and its organization			1	1	2
Topic 9. Scientific research in the field of chemistry					2
Topic 10. Main directions of postgraduate research			1	1	2
Topic 11. Carrying out of graduate student’s research			1		2
Topic 12. Search, systematization of information in the course of scientific research			1	1	4
Topic 13. Dissertation: requirements, order of preparation and design			1	1	4
Topic 14. Abstract: preparation and publication. Scientific publications			1	1	4
Amount of hours in second module			**6**	**5**	**20**

5. PRACTICAL WORK

№	Topic	Hrs
First module. CONCEPT OF SCIENCE		
1.	Scientific knowledge. Object, subject, content, tasks and structure of the course	1
2.	The structure of scientific knowledge. Specification of research activities	
3.	Research process organization	1
4	Scientific research methods	
5	Conditions and organization of graduate student's work.	1
6	Theoretical research in the field of chemistry	1
7	Experimental research in the field of chemistry	
Second module: SCIENTIFIC ACTIVITY AS A MEANS OF KNOWLEDGE		
8	Scientific activity in Ukraine. Comparison with other countries.	1
9.	Main directions of postgraduate research	
10	Carrying out postgraduate research	1
11	Search, systematization of information during scientific research	11
12	Dissertation: requirements, order of preparation and design	1
13	Abstract: preparation and publication. Scientific publications	1
14	Scientist profiles.	
Amount of hours:		**9**

6. INDIVIDUAL WORK

№	Topis	Hrs
	First module. CONCEPT OF SCIENCE	
1.	Object, subject, content, tasks and structure of the course i) Lecture material elaboration ii) Description of the function of science. iii) Classification of fundamental and applied sciences. iv) Review of the main and additional literature on the topic.	2
2.	The essence and structure of scientific knowledge. Terminological apparatus of science. i) Lecture material elaboration. ii) Definition of scientific terms, categories, concepts, paradigms, laws, regularists for post-graduate research and post-graduate work iii) Description of the hypothesis and assumptions that will be tested in the dissertation work. iv) Review of the main and additional literature on the topic.	2
3.	Organization of the research process i) Lecture material elaboration. ii) Carrying out an analysis of the input data of the postgraduate student study. iii) Preparation of a specific work plan for carrying out scientific research in the field of work of a graduate student. iv) Review of the main and additional literature on the topic.	2
4	Methodology and methods of scientific research i) Lecture material elaboration. ii) Describe the methodological apparatus of the research - the idea, the relevance of the research, the object of the research, the subject of the research, the purpose, the hypothesis of the research, the task of the research, the content and structure iii) Review of the main and additional literature on the topic	2
5	Organization of graduate student's work during scientific research i) Lecture material elaboration. ii) Description of the stages of scientific research. iii) Preparation a detailed plan and schedule of the graduate student's scientific research. iv) Review of the main and additional literature on the topic.	4
6	Theoretical study i) Lecture material elaboration. ii) Description of the theoretical foundations of the graduate student's scientific research. iii) List the mathematical apparatus with which scientific research will be carried out. iv) Review of the main and additional literature on the topic	4
7	Experimental study	4

	i) Lecture material elaboration ii) Acquaintance with the experimental base and work methods of the graduate student. iii) Prepare a work plan and the necessary experimental tools to implement the testing of hypotheses and assumptions. iv) Review of the main and additional literature on the topic	
Second module: SCIENTIFIC ACTIVITY AS A MEANS OF KNOWLEDGE		
8	Scientific activity in Ukraine and its organization i) Lecture material elaboration ii) Acquaintance with the activity of scientific institutions of Ukraine iii) Description of the requirements for awarding the scientific degree of DOCTOR OF PHILOSOPHY. iv) Review of the main and additional literature on the topic	2
9	Scientific research in chemistry i) Lecture material elaboration ii) Research methods in chemistry iii) Physical methods of research of chemical processes iv) Review of the main and additional literature on the topic	2
10	The main directions of postgraduate studies i) Lecture material elaboration ii) Review of the main and additional literature on the topic	2
11	Carrying out postgraduate research i) Lecture material elaboration. ii) Describe the stages of postgraduate research. iii) List the risks of not completing postgraduate research on time. iv) Review of the main and additional literature on the topic	2
12	Search, systematization of information during scientific research i) Lecture material elaboration. ii) Creation ORCID, Researcher ID, Google Scholar profiles. iii) Formation of a list of scientific sources in Mendeleev or EndNote, according to the topic of the dissertation. iv) Review of the main and additional literature on the topic	4
13	Thesis: requirements, order of preparation, and design. i) Lecture material elaboration. ii) To study the requirements for the thesis for obtaining the scientific degree of Doctor of Philosophy iii) To analyze the author's justification of the problem and the choice of the topic of scientific research on the example of one of the abstracts of thesis in the field of chemistry. iv) Carrying out a systematic analysis of the structural adequacy of the thesis. v) Review of the main and additional literature on the topic	4
14	Abstract: preparation and publication. Scientific publications i) Lecture material elaboration.	4

	ii) Studying the requirements for the abstract and the procedure for registration. iii) Analysis the justification of the choice of the object and subject, the goal and tasks of scientific research on the example of one of the dissertation abstracts in the field of chemistry. iv) Criteria of conformity of scientific publications made by the applicant for their use in the abstract of the dissertation work. v) Review the main and additional literature on the topic.	
	Amount of hours:	**40**

7. TEACHING METHODS

- Verbal methods: explanation, instruction, story, lecture, conversation (reproductive, heuristic), independent work with the textbook, discussion of problems, educational discussions, brainstorming, case methods, testing, cross-checking of knowledge;
- Visual: the method of illustrations (diagrams, tables, graphs, etc.), the method of demonstrations (devices, experiments, technical installations, video films);
- Method of instruction; Reproductive methods: explanatory, illustrative, reproducible;
- Problem-based learning methods (problem presentation, heuristic, experimental).

Obligatory elements of the educational work of graduate students are clear control of class attendance, fair differentiation of grades, and encouragement of their educational activity.

8.GRADE SCALING DURING COURSE

Grade scaling during course														Exam	Grade
First module							Second module							100	100
T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14		
8	8	8	8	5	8	8	8	5	5	5	8	8	8		

9.ECTS GRADING SCALE

Grading scale	GRADE ECTS	Grade on a national standard	
		Exam	Test
90–100	A	Excellent	To pass
80–89	B	Good	
70–79	C		
65–69	D	Satisfactory	
60–64	E		
35–59	FX	Fail Some more work required before the credit can be awarded	Fail Some more work required before the credit can be awarded
0–34	F	Fail Considerable further work is required	Fail Considerable further work is required

9. METHODOLOGICAL SECURITY

The educational and methodical complex of studying the discipline contains the working program of the educational discipline, the program of the educational discipline, a synopsis of lectures from the course, presentations created by means of Power Point.

Blackboards with chalk and felt-tip pens, a laptop, a multimedia projector, and a laser pointer are used to methodically support the lecture process**.**

EXAMINATION CARD # 1

1. The essence of science and scientific activity.
2. Catalogs: principles of their formation.
3. Scientific experiment: concepts and types.
4. Requirements for the content of the dissertation.

EXAMINATION CARD # 2

1.General concepts and definitions of the process of cognition.
2. Organization of work with scientific literature. Forming a list of scientific sources in Mendeleev.
3. Methodology of experimental research planning.
4. Requirements for the structure of the thesis.

EXAMINATION CARD # 3

1. Methods of scientific knowledge.
2. Research methods and techniques.
3. The sequence of scientific research.
4. Methodology of publication preparation and design. The process of preparing a manuscript, its submission, review and publication.

EXAMINATION CARD # 4

1. Stages of scientific research.
2. Search for scientific information using the ScienceDirect platform, Research4Life, Scopus database.
3. Choice of direction and sequence of scientific research.
4. Requirements for the structure and content of the abstract.

EXAMINATION CARD # 5

1. Object and subject of scientific research.
2. Profile of a scientist ORCID ID, Researcher ID, Google Scholar and its arrangement.
3. Drawing up individual and work plans.
4. Approbation of research results.

EXAMINATION CARD # 6

1. Classification of scientific research.
2. Analysis of scientific literature on the topic.
3. Justification of the relevance of the topic of scientific research.
4. Conclusions as an important component of the thesis.

EXAMINATION CARD # 7

1. Basics of scientific knowledge.
2. Principles of information material collection.
3. Scientific novelty of research results.
4. Structure and stages of thesis.

РЕКОМЕНДОВАНА ЛІТЕРАТУРА

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