

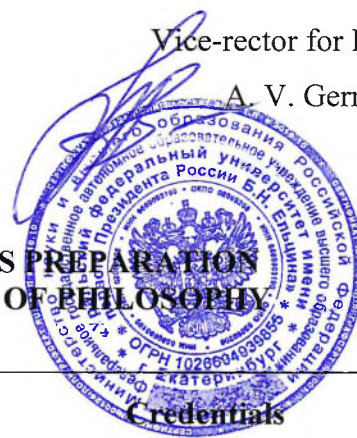
The ministry of science and higher education of the Russian Federation
 Federal state autonomous educational institution of higher education
 «Ural federal university named after the first President of Russia B. N. Yeltsin»
 Institute of new materials and technologies

APPROVED

Vice-rector for Research

A. V. Germanenko

2022



**THE PROGRAM OF RESEARCH AND THESIS PREPARATION
 FOR THE ACADEMIC DEGREE OF DOCTOR OF PHILOSOPHY**

List of information about the working program of the discipline	Credentials
Doctoral program: Technology of organic substances	Code DP 2.6.10
Group of specializations Chemical technologies, material sciences, metallurgy	Code 2.6.
Federal state requirements (FSR)	Order of the Ministry of science and higher education of the Russian Federation of 20.10.2022 № 951
Independently approved requirements (IAR)	Order «On the introduction of «Requirements to the development and implementation of academic staff training programs in the UrFU doctoral course» of 31.03.2022 № 315/03

Yekaterinburg
 2023

Description of the academic staff training program in the doctoral course (hereinafter referred to as the doctoral program) is compiled by:

№	Full name	Academic degree, academic title	Occupational title	Research unit
1	Zyrianov Grigory Vasil'evich	D.Sc., Professor	Professor	Department of organic and biomolecular chemistry
2	Glukhareva Tatiana Vladimirovna	PhD, Associate Professor	Associate Professor	Department of technology for organic synthesis

Recommended by:

Educational and methodological board of the Institute of chemical engineering

Report № 1 of 10.01.2023

Chairman of the educational and methodological board of the institute

A. B. Darintseva

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1. GENERAL DESCRIPTION OF THE PROGRAM OF RESEARCH AND THESIS PREPARATION FOR THE ACADEMIC DEGREE OF DOCTOR OF PHILOSOPHY

1.1. Annotation

The program «Research and thesis preparation for the academic degree of Doctor of Philosophy» (hereinafter referred to as «the doctoral research») has been designed based on independently approved requirements and order of the vice-chancellor «On the introduction of «Requirements to the development and implementation of academic staff training programs in the UrFU doctoral course» of 31.03.2022 № 315/03 and is included into Section 3 «Electives» of educational plans for doctoral programs.

The doctoral research aims:

- Training of a doctoral student for independent research, shaping scientific worldview, professional perspectives, formation and improvement of skills for independent research including scientific problem statement and adjustment, work with various sources of research and technical information.
- Carrying out original research independently and in a research group, discussion of the doctoral research in the process of free discussion in a professional environment, preparation of the doctoral research results for publication, as well as writing and preparing a thesis for the scientific degree of Doctor of Philosophy in the chosen scientific specialization.

The content of the doctoral research is defined in accordance with the chosen scientific specialization and the doctoral thesis topic.

The main doctoral research objectives for doctoral students are:

- formation of a system of knowledge and skills in planning, organization, and step-by-step implementation of research;
- acquisition of skills in working with bibliographic reference books, compiling reference lists, and using bibliographic information in research papers;
- development of information and analytical skills in working with electronic databases of local and foreign library collections;
- formation and development of skills and abilities for applying research methods to solve the assigned research challenges;
- formation and development of skills and abilities for the design and implementation of complex studies;
- formation and development of skills and abilities for scientific and experimental work with an empirical research base in accordance with the chosen doctoral thesis topic;
- mastering the methods of observation, experiment, and modeling;
- acquisition of skills for group research, productive interaction with other research groups (divisions) and researchers;
- formation of skills and abilities in scientific communications, public discussion of the research results, improvement of the professional and communicative culture of the future teacher-researcher;
- formation of skills to complete documentation, doctoral thesis, and scientific report in accordance with the requirements.

The research of a doctoral student is carried out under the guidance of a supervisor, both in the classroom and in out-of-class forms. It is carried out in the form of the implementation of a research project performed by a doctoral student within the approved doctoral thesis topic.

The doctoral research includes the following forms:

- conducting independent research on the chosen doctoral thesis topic;

- scientific publications in accordance with the requirements of the Higher attestation commission of the Ministry of science and higher education of the Russian Federation, the UrFU attestation council;
- participation in scientific conferences, doctoral thesis writing ;
- conducting specific non-standard research tasks during the period of research practice, research activity, and thesis preparation for the scientific degree of Doctor of Philosophy.

Research activity is an active form of conducting research by a doctoral student, designed:

- to develop the skills and competencies of research and information–analytical work in the process of thesis preparation;
- to make research and information–analytical work a permanent and systematic element of research and teaching activity;
- to involve doctoral students in the active life of the scientific and expert community.

The following can be counted as doctoral research:

- participation of a doctoral student in research grants and other research projects;
- participation of a doctoral student in academic exchange programs;
- participation of doctoral students in the creative cooperation works within the framework of the state, inter-, or intra-university grants;
- state registration of intellectual activity (inventions, utility models, industrial designs, selection inventions, certificates of state registration of computer programs, databases, topographies of integrated circuits, trademarks and service marks, etc.);
- participation of doctoral students in open competitions for the best research (provision of scientific, research papers, which are independently performed research on challenges of technical sciences), conducted according to orders of federal and regional authorities.

1.2. The language of the program – Russian.

1.3. The expected research activity outcomes

The research activity is aimed at the formation of the following doctoral student competencies:

- the ability to critically analyze and evaluate modern scientific advances, and generate new ideas for solving research and practical problems, including in interdisciplinary areas;
- the ability to design and carry out complex research, including interdisciplinary research, based on a holistic system scientific worldview using knowledge in the field of the history and philosophy of science;
- the readiness to participate in the work of Russian and international research groups to solve scientific and educational problems;
- the readiness to use modern scientific communication methods and technologies in official and foreign languages;
- the ability to follow ethical professional standards;
- the ability to plan and solve problems of professional and personal development;
- the ability and readiness to substantiate theoretically and optimize the technological processes for manufacturing advanced materials and new products, taking into account the social, economic, and environmental consequences;
- the ability and readiness to develop and issue technological documentation for advanced materials, new products, and means of technical product quality control;
- the ability and readiness to economically evaluate the manufacturing and non-manufacturing costs for new materials and products production, to work for their depreciation and quality improvement;
- the ability and readiness to comply with manufacturing and operational safety regulations;

- the ability and readiness to use in practice the integrated knowledge of natural sciences, general professionally oriented and special disciplines to understand the problems of the development of materials science, the ability to put forward and put into practice new highly efficient technologies;
- the ability and readiness to perform computer-assisted theoretical and experimental research being a leading performer;
- the ability and readiness to conduct a patent search on research topics, prepare materials for patent acquisition, the ability to analyze, systematize and generalize information from global computer networks;
- the ability and readiness to process the research results, and prepare scientific and technical reports, as well as prepare scientific papers and reports for publication;
- the ability and readiness to develop technical specifications and programs for carrying out theoretical and experimental work;
- the ability to choose instruments, sensors, and equipment for conducting experiments and recording their results;
- the ability and readiness to develop a technological process, technological equipment, working documentation, process and operational flow charts for the manufacturing of new products from advanced materials;
- the ability and readiness to participate in technological experiments, to carry out technological control in the materials and products production;
- the ability and readiness to participate in the certification of materials, semi-finished products, products, and technological processes for their manufacturing;
- the ability and readiness to assess investment risks in the implementation of innovative materials science and design technology projects and the introduction of advanced materials and technologies;
- the ability and readiness to develop the implementation measures of the developed projects and programs;
- the ability and readiness to organize work to improve, modernize, and unify manufactured products, and their elements, to develop draft standards and certificates, to certify materials, technological processes, and equipment, to participate in activities for a quality system creation;
- the ability and readiness to manage the teamwork, to participate in scientific research planning;
- the ability and readiness to conduct designer supervision over the manufacturing, installation, setting up, testing, and commissioning of manufactured materials and products;
- the readiness for teaching in the main higher education programs;
- the ability and readiness to demonstrate a systematic understanding of the current state and problems of the chosen (professional) branch of scientific knowledge;
- the ability and readiness to conduct research in the chosen (professional) branch of scientific knowledge using modern methods and technologies;
- the readiness to identify and develop issues using a scientific approach, to conduct and implement research results in the chosen (professional) branch of scientific knowledge;
- the ability to analyze, process and present scientific and professional information;
- the ability and readiness to make a scientific contribution to the development of the chosen (professional) branch of scientific knowledge as a result of scientific research;
- the ability to critically analyze, evaluate and develop new ideas in the chosen (professional) branch of scientific knowledge, and related fields;
- the ability and readiness to share accumulated knowledge and experience with colleagues, scientific communities in educational institutions of higher education, and continuing professional education;
- the ability and readiness for career growth in academic or professional activities in the context of technological, social, and cultural progress in a knowledge society.

During the doctoral research and thesis preparation, a doctoral student should master the methods and techniques of scientific research organization for the professional field processes in order to solve educational, scientific, and social problems, and should learn how to analyze, interpret and present the results in the form of materials.

As a result of the doctoral research and thesis preparation, a doctoral student should demonstrate the following results:

Know:

- methods, techniques, and technologies of science communication;
- the main advances and trends in the development of the relevant subject and scientific field and its relationship with other sciences;
- modern approaches to research modeling;
- fundamentals of scientific and methodological work in higher education;
- the procedure for organizing, planning, conducting, and supporting research using the latest technologies;
- scientific culture and professional skill fundamentals;
- basic principles, methods, and forms of organization of the scientific process at the university;
- methods for monitoring and evaluating the quality of scientific results;

Be able to:

- use scientific technologies, methods, and techniques of science communication;
- use modern technical means when presenting the research results;
- the basis for the use of computer equipment and information technology in science communication;
- engage in group research;

Demonstrate:

- the methods of using technical means for research results presenting;
- the technique of oral and written scientific speech;
- presentation of the research results using modern computer technologies;
- self-assessment and self-analysis methods of the research results and effectiveness.

During the research seminars, a doctoral student should demonstrate:

- the ability to review and analyze scientific literature, the choice of research direction (adjustment, if necessary);
- the skills of conducting scientific research: collecting empirical and analytical material and its theoretical generalization; suggestion of hypotheses and their development into theoretical systems and substantiation;
- the skills of public scientific discussion and presentation of the research results, scientific papers preparation and writing.

1.4.The doctoral research loads

#	Types of educational work	Discipline load		Load distribution across semesters (hours)							
		Total hours	Including work with a lecturer (hours)	1	2	3	4	5	6	7	8
5.	Independent work of doctoral students, including all types of continuous assessments	7812	32	828	828	1080	1080	1080	972	1080	864
6.	Midterm assessment	Credit		C	C	C	C	C	C	C	C
7.	Total load of curriculum, hours	7812	32	828	828	1080	1080	1080	972	1080	864
8.	Total load of curriculum, credit points	217		23	23	3	30	30	27	30	24

2. THE CONTENT OF RESEARCH AND THESIS PREPARATION FOR THE ACADEMIC DEGREE OF DOCTOR OF PHILOSOPHY

2.1. The load and content of doctoral research

#	Research activity section and thesis preparation	Content
1	Section I. Scientific problem statement and adjustment for the thesis	Identification of the research object and method. Design of the plan for the doctoral research and thesis for the academic degree of Doctor of Philosophy. Literature search methods: use of library collections and indexes, abstracting journals, automated search tools, and review of periodical literature.
2	Section II. Work with the sources of scientific and technical information relevant to the research topic	Review and analysis of information relevant to the thesis topic: reviews, referencing catalogs, abstracting catalogs. Preparation of an analytical review of scientific, technical and patent literature relevant to the thesis topic.
3	Section III. Independent research	Theoretical part of the research. Practical part of the research. Equipment: experimental setups, devices, apparatus, software. Stages and methods of conducting theoretical and experimental research or computer modeling. Parameters controlled during the research. Criteria for evaluating the efficiency of the investigated object, process, and device. Processing and analysis of the research results.
4	Section IV. Preparation of presentations and reports on the obtained research. Presenting at scientific seminars and conferences	Technologies for preparing presentation materials, the structure and style of presentations depending on the target audience and the speech duration.
5	Section V. Preparation of publications based on the research results in peer-reviewed scientific journals recommended by the Higher Attestation Commission of Russia and the UrFU Attestation Council for the publication of thesis materials	Preparation of scientific publication: abstracts, a journal article, a monograph. The structure of abstracts, an article, and a monograph. Presenting at seminars, scientific conferences, symposiums, and meetings.

6	Section VI. Preparation of applications and reports on grants relevant to the research topic	Preparation and structure of a grant application. Project description: used methodology; research materials and methods; project conditions; list of steps for achieving the positioned goals; plan and technology for implementation of every step; the general project implementation mechanism. The expected results: publications that will be prepared during the project; possible future application of the results.
7	Midterm and annual assessments	Midterm and annual assessments according to individual plans of the departments and the Academic Council of the corresponding UrFU institute.

2.2. Independent work of doctoral students

Research section and thesis preparation	Types of independent work	Load of study time credit points / hours
Section I	Work with literature, databases and the preparation of a working plan	12 / 432
Section II	Work with literature and preparation of analytical review of scientific and technical information as well as patent literature	36 / 1296
Section III	Implementation of the theoretical and practical parts of the research project, processing, and analysis of research results	92 / 3312
Section VI	Preparation of reports and presentations for scientific conferences	12 / 432
Section V	Scientific publications writing	30 / 1080
Section VI	Writing grant applications and reports	23 / 828
Section VII	Preparation of progress reports	12 / 432

The distribution of the workload of certain types of research activities for each study year within the limits of the total intensity is not regulated. Within the framework of the individual doctoral curriculum, agreed with the supervisor and approved by the head of the department, it is possible to redistribute the intensity of certain types of doctoral research work within the intensity of each study year.

3. THE SET OF TOOLS FOR CONTINUOUS AND MIDTERM DISCIPLINE ASSESSMENT

3.1. The evaluation criteria for the results of the control test activities of continuous and midterm doctoral research assessment

Applied evaluation criteria of the achievements of doctoral students for each control test activity were approved by the Institute of new materials and technologies. The evaluation criteria system is based on three levels of mastering the competence components: intermediate, advanced, high.

Competence components	Indications of the level of competence components acquisition		
	intermediate	advanced	high
Knowledge	The doctoral student demonstrates knowledge-familiarity, knowledge-copy: recognizes objects, phenomena, and concepts, finds differences between them, shows knowledge of the information sources, and can independently perform reproductive actions on knowledge by independently reproducing and applying information.	The doctoral student demonstrates analytical knowledge: confidently reproduces and understands the acquired knowledge, assigns it to one or another classification group, independently systematizes it, establishes relationships between them, and applies it productively in familiar situations.	The doctoral student is able independently to extract new knowledge from the world, creatively apply it for problem-solving in new and non-standard situations.
Skills	The doctoral student is able correctly to follow prescribed instructions and algorithms in a familiar situation, and independently solves typical tasks that require choosing from known methods in a predictably changing situation.	The doctoral student is able independently to perform actions techniques, operations) to solve non-standard tasks that require a choice based on a combination of known methods in an unpredictably changing situation.	The doctoral student is able independently solve to research problems and demonstrates the creative application of skills (technologies).
Personality	The doctoral student has low motivation for learning, shows an indifferent, irresponsible attitude to learning and assigned work.	The doctoral student demonstrates high motivation to learning, shows positive attitude towards study and the future career, demonstrates activity.	The doctoral student demonstrates strong motivation to learning and work, shows persistence and enthusiasm, diligence, independence, and creativity.

3.2. The tools for continuous assessment

The assessment is carried out in the form of doctoral student annual reports at the department meetings.

3.3. The tools for midterm assessment

Scientific reports on the topic of published papers and thesis.

Thesis examination after its writing.

Discussion of the thesis at the department meeting and recommendation for defense.

4. EDUCATIONAL AND METHODOLOGICAL, AND INFORMATIONAL SUPPORT

4.1. Recommended literature

4.1.1. Main literature

1. Hopkins, D. W.; Coudurier, L.; Wilkomirsky, I. *Fundamentals of Metallurgical Processes*. 2 ed.; Pergamon: 2014; p 416.
2. Sauveur, A. *Laboratory Experiments in Metallurgy*. Forgotten Books: 2017; p 158.
3. Guthrie, R. I. L. *Engineering in Process Metallurgy*. Oxford Science Publications: 1992; p 544.
4. Tamhane, A. C. *Statistical Analysis of Designed Experiments: Theory and Applications*. 1 ed.; Wiley-Interscience: 2009; p 720.
5. Herzog, M. H.; Francis, G.; Clarke, A. *Understanding Statistics and Experimental Design*. Springer Cham: 2019; p 142.
6. Booth, W. C.; Colomb, G. G.; Williams, J. M.; Bizup, J.; Fitzgerald, W. T. *The Craft of Research*. 4 ed.; University of Chicago Press: 2016; p 336.
7. Thomas, G. *How to Do Your Research Project: A Guide for Students*. 4 ed.; SAGE Publications Ltd: 2022; p 368.
8. Silvia, P. J. *How to Write a Lot: A Practical Guide to Productive Academic Writing*. 2 ed.; American Psychological Association: 2018; p 110.
9. Bright Wilson Jr., E. *An Introduction to Scientific Research*. Dover Publications: 1991; p 400.
10. Dunleavy, P. *Authoring a PhD: How to Plan, Draft, Write and Finish a Doctoral Thesis or Dissertation*. Red Globe Press: 2003; p 297.
11. Schimel, J. *Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded*. Oxford University Press: 2011; p 221.
12. McCarthy, P.; Hatcher, C. *Presentation Skills: The Essential Guide for Students (Study Skills)*. 1 ed.; SAGE Publications Ltd: 2002; p 228.
13. Morgan, S.; Whitener, B. *Speaking about Science: A Manual for Creating Clear Presentations* 1ed.; Cambridge University Press: 2006; p 138.

4.1.2. Additional literature

1. Creswell, J. W. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 2 ed.; SAGE Publications, Inc: 2002; p 272.
2. Bell, J. *Doing Your Research Project (Open Up Study Skills)*. 5 ed.; Open University Press: 2010; p 296.
3. Christensen, L.; Johnson, R.; Turner, L. *Research Methods, Design, and Analysis*. 12 ed.; Pearson: 2014; p 552.

4.2. Periodicals

The original articles and monographs on the thesis topic recommended by the supervisor.

4.3. Electronic educational sources

1. Zonal scientific library <http://lib.urfu.ru/course/view.php?id=167>
2. UrFU electronic resources <http://lib.urfu.ru/mod/data/view.php?id=2802>
3. Library catalogue <http://lib.urfu.ru/course/view.php?id=181>

4.4. Databases, information reference, and search systems

All doctoral students have full access to the listed resources, including authorized access via Internet:

1. ScienceDirect <https://www.sciencedirect.com/>
2. Web of Science <https://www.webofknowledge.com>
3. Scopus: <http://www.scopus.com>
4. SciFinder: <http://www.scifinder.com>
5. Reaxys: <http://reaxys.org>
6. Academic Search Ultimate EBSCO publishing <http://search.ebscohost.com>
7. Federal Institute of Industrial Property <https://www1.fips.ru/en/>
8. Search system Google Search <https://www.google.com/>

4.5. Software

1. Microsoft office (Word, Excel, Power point, VISIO)
2. Adobe Reader
3. Mathcad 2014
4. Compas 8-12
5. Statistica 6

5. LOGISTIC DISCIPLINE SUPPORT

5.1. Details on the specialized and laboratory equipment availability

For the doctoral research and the thesis preparation for the academic degree of Doctor of Philosophy, the Ural Federal University has specialized premises for group and individual meetings, continuous and midterm assessments, as well as research laboratories, independent student work premises, as well as premises for equipment storage and preventive maintenance.