MINISTRY OF EDUCATION AND SCIENCE 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»

Ural Power Engineering Institute

APPROVED

Pro-rector for research

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ V. V. Kruzhaev

«\_\_\_» \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2018

**PROGRAM OF THE   
RESEARCH ACTIVITIES   
AND PREPARATION OF THE QUALIFYING SCIENTIFIC WORK (DISSERTATION) FOR THE DEGREE OF CANDIDATE OF SCIENCES**

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| --- | --- |
| **List of information on the course work program** | **Registration details** |
| **Educational program**  Electromechanics and Electrical Apparatuses | **EP code**  13.06.01/05.01  Curriculum No. 6921 |
| **Field of study:**  Electro- and heating engineering | **Field of study and qualification code**  13.06.01  **Code of the scientific specialty**  05.09.01 |
| **Qualification**  Training of Upper Level Personnel |
| **ФГОС ВО** | **Information on the order of the RF Ministry of Education and Science on the approval of the HE FSES**:  Order No. 878 dd.June 30, 2014   revised and expanded dd. April 30, 2015 |

**Ekaterinburg, 2018**

1. GENERAL CHARACTERISTICS

**1.1.** **Annotation**

In the educational program structure the module “Research activities and preparation of the qualifying scientific work (dissertation) for the degree of candidate of sciences” is included in the variable part of the educational program of the higher educational institution and is studied alongside with other modules expect for the “Final state attestation” module.

The objective of research activities is the formation of planned results of the educational program learning alongside with other disciplines of the educational program and preparation of a scientific report about main results of the qualifying scientific work (dissertation) for the degree of candidate of sciences.

The role of researches in the formation of anticipated results of the educational program learning is given in art.1.5.

1.2. Structure of practicums, their terms and duration

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| --- | --- | --- | --- | --- |
| Item No. | Type | Semester number | Scope of researches as per the curriculum | |
| in hours | in c.p. |
| 1. | Research activities and preparation of the qualifying scientific work (dissertation) for the degree of candidate of sciences | 1 | 648 | 18 |
| 2 | 864 | 24 |
| 3 | 936 | 26 |
| 4 | 936 | 26 |
| 5 | 936 | 26 |
| 6 | 936 | 26 |
| 7 | 1044 | 29 |
| 8 | 720 | 20 |
| Total | | | 7020 | 195 |

**1.3. Bases for the research execution, forms of researches**

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| --- | --- | --- | --- |
| Item No. | Research types | Forms of researches | Research methods for their execution |
| 1. | Theoretical researches on the topic of the qualifying scientific work (dissertation) | Studying of scientific and technical literature on the topic of the qualifying scientific work (dissertation).  Development of mathematical models on the topic of the qualifying scientific work (dissertation).  Mathematical modeling по теме on the topic of the qualifying scientific work (dissertation).  Guidance for the execution of theoretical researches of bachelors and/or masters | Stationary,  *location –* Federal State Autonomous Educational Institution of Higher Education «Ural Federal University named after the first President of Russia B.N.Yeltsin» (Ekaterinburg) |
| 2. | Experimental researches on the topic of the qualifying scientific work (dissertation) | Experimental researches on the topic of the qualifying scientific work (dissertation) | Stationary  Enterprises:  1. Federal State Autonomous Educational Institution of Higher Education «Ural Federal University named after the first President of Russia B.N.Yeltsin»(Ekaterinburg) |

1.4. Research organization procedure

The order of the research’s planning, organization and execution, form of the research’s execution and their attestation are formulated in accordance with current provisions of regulatory documents.

**1.5. Anticipated results of researches**

The result of performed researches is the formation of the following learning outcomes and competences:

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| --- | --- | --- |
| Item | **Practice type** | **Learning outcomes** |
| 1. | Theoretical researches on the topic of the qualifying scientific work (dissertation) | РО-2:  UC‑1; UC‑3; UC‑4; UC‑5; UC‑6;  GPC‑1; GPC‑2; GPC‑3; GPC‑4; GPC‑5;  PC‑1; PC‑2; PC‑3; PC‑4; PC‑5; PC‑6; PC‑7; PC-8. |
| 2. | Experimental researches on the topic of the qualifying scientific work (dissertation) | РО-1:  UC‑1; UC‑2; UC‑3; UC‑4; UC‑5; UC‑6;  GPC‑1; GPC‑2; GPC‑3; GPC‑4;  PC‑1; PC‑2; PC‑3; PC‑4; PC‑5; PC‑6; PC‑7. |

As a result of the practicum, the post-graduate student shall master and demonstrate professional practical knowledge and skills, experience:

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| --- | --- | --- |
| No. | **Practicum type** | **Training results** |
| 1. | Theoretical researches on the topic of the qualifying scientific work (dissertation) | UC-1  *Have:* the ability to critically analyze and assess modern scientific achievements, generate new ideas when solving research and practical tasks, including tasks in interdisciplinary areas.  *Be able to*: generate new technical solutions of research and practical tasks, including tasks in interdisciplinary areas.  *Know:* modern scientific achievements, including achievements in interdisciplinary areas.  UC-3  *Have:* practical skills of participation in Russian and international research groups on solving scientific and research tasks.  *Be able to* communicate in a research group in Russian and foreign language when solving scientific and educational tasks.  *Know:* scientific and educational tasks, a foreign language to the extent required for solving scientific and educational tasks.  UC-4  *Have:* practical skills in using modern methods and technologies of the scientific communication in state and foreign languages.  *Be able to* use modern methods and technologies of the scientific communication in state and foreign languages.  *Know:* modern methods and technologies of the scientific communication in state and foreign languages.  UC-5  *Have:* practical skills in following ethical standards in professional activities.  *Be able to* follow ethical standards in professional activities.  *Know:* ethical standards.  GPC-1  *Have:* practical skills in theoretical and experimental researches in the field of professional activities.  *Be able to*: perform theoretical and experimental researches in the field of professional activities.  *Know:* the methodology of theoretical and experimental researches in the field of professional activities.  GPC-2  *Have:* practical skills of a research with the use of latest information and communication technologies.  *Be able to*: research latest information and communication technologies.  *Know:* latest information and communication technologies.  GPC-3  *Have:* practical skills of participation in the development of new research methods and their use in personal research activities in the field of professional activities.  *Be able to*: autonomously perform researches with the use of modern methods in the field of professional activities.  *Know:* new research methods.  GPC-4  *Have:* practical skills of organization of work of a research group in the field of professional activities.  *Be able to*: organize work of a research group in the field of professional activities.  *Know:* methods of organization of a safe execution of group works in the field of professional activities.  GPC-5  *Have:* practical skills in teaching activities on main educational programs of higher education for the undergraduate education and/or master’s degree program on the specialty.  *Be able to*: perform teaching activities on main educational programs of higher education for the undergraduate education and/or master’s degree program on the specialty.  *Know:* the methodology of teaching activities on the specialty.  PC-1  *Have:* practical skills in planning, preparation and execution of experimental researches on the specialty “Electromechanics and Electrical Apparatuses”.  *Be able to:* plan, prepare and perform experimental researches on the specialty “Electromechanics and Electrical Apparatuses”.  *Know:* methods of execution of experimental researches on the specialty “Electromechanics and Electrical Apparatuses”.  PC-2  *Have:* practical skills in processing experiment results on the specialty “Electromechanics and Electrical Apparatuses”.  *Be able to:* process experiment results on the specialty “Electromechanics and Electrical Apparatuses”.  *Know:* methods of processing experiment results on the specialty “Electromechanics and Electrical Apparatuses”.  PC-3  *Have:* practical skills in the development of mathematical models of general-purpose or special electromechanical converters or electrical apparatuses.  *Be able to:* develop mathematical models of general-purpose or special electromechanical converters or electrical apparatuses for performing researches.  *Know:* methods of mathematical modeling and mathematical models general-purpose or special electromechanical converters or electrical apparatuses.  PC-4  *Have:* practical skills in the development of mathematical models and algorithms for solving tasks in the field of the scientific specialty.  *Be able to:* develop mathematical models and algorithms for solving tasks in the field of the scientific specialty.  *Know:* mathematical models and algorithms for solving tasks in the field of the specialty.  PC-5  *Have:* practical skills in the use of modern software packages for solving tasks of the scientific specialty.  *Be able to:* use modern software packages for solving tasks of the scientific specialty.  *Know:* limitations of the field of application of modern software packages for solving interconnected tasks of the scientific specialty.  PC-6  *Have:* practical skills in collection, processing, analysis and systematization of the information on the research topic, selection of methods and means of research task solving.  *Be able to:* perform collection, processing, analysis and systematization of the information on the research topic, select methods and means of research task solving.  *Know:* methods and means of research task solving.  PC-8.  *Have:* practical skills of communication with one student and a group of students during the in-class learning.  *Be able to*: appropriately formulate the content of lectures.  *Know:* modern problems and achievements of the “Electromechanics and Electrical Apparatuses” specialty. |
| 2. | Experimental researches on the topic of the qualifying scientific work (dissertation) | UC-1  *Have:* the ability to critically analyze and assess modern scientific achievements, generate new ideas when solving research and practical tasks, including tasks in interdisciplinary areas.  *Be able to*: generate new technical solutions of research and practical tasks, including tasks in interdisciplinary areas.  *Know:* modern scientific achievements, including achievements in interdisciplinary areas.  UC-2  *Have:* ability to design and perform comprehensive researches, including interdisciplinary researches, on the basis of a coherent system scientific world view with the use of knowledges in the science history and philosophy.  *Be able to*: design and perform comprehensive researches, including interdisciplinary researches, on the basis of a coherent system scientific world view with the use of knowledges in the science history and philosophy.  *Know:* science history and philosophy to the extent of the post-graduate educational program.  UC-3  *Have:* practical skills of participation in Russian and international research groups on solving scientific and research tasks.  *Be able to* communicate in a research group in Russian and foreign language when solving scientific and educational tasks.  *Know:* scientific and educational tasks, a foreign language to the extent required for solving scientific and educational tasks.  UC-4  *Have:* practical skills in using modern methods and technologies of the scientific communication in state and foreign languages.  *Be able to* use modern methods and technologies of the scientific communication in state and foreign languages.  *Know:* modern methods and technologies of the scientific communication in state and foreign languages.  UC-5  *Have:* practical skills in following ethical standards in professional activities.  *Be able to* follow ethical standards in professional activities.  *Know:* ethical standards.  UC-6  *Have:* practical skills in planning and solving tasks of own professional and individual development philosophy to the extent of the post-graduate educational program.  *Be able to*: plan and solve tasks of own professional and individual development philosophy to the extent of the post-graduate educational program.  *Know:* methods of planning and solving tasks of own professional and individual development philosophy to the extent of the post-graduate educational program.  GPC-1  *Have:* practical skills in theoretical and experimental researches in the field of professional activities.  *Be able to*: perform theoretical and experimental researches in the field of professional activities.  *Know:* the methodology of theoretical and experimental researches in the field of professional activities.  GPC-2  *Have:* practical skills of a research with the use of latest information and communication technologies.  *Be able to*: research latest information and communication technologies.  *Know:* latest information and communication technologies.  GPC-3  *Have:* practical skills of participation in the development of new research methods and their use in personal research activities in the field of professional activities.  *Be able to*: autonomously perform researches with the use of modern methods in the field of professional activities.  *Know:* new research methods.  GPC-4  *Have:* practical skills of organization of work of a research group in the field of professional activities.  *Be able to*: organize work of a research group in the field of professional activities.  *Know:* methods of organization of a safe execution of group works in the field of professional activities.  PC-1  *Have:* practical skills in planning, preparation and execution of experimental researches on the specialty “Electromechanics and Electrical Apparatuses”.  *Be able to:* plan, prepare and perform experimental researches on the specialty “Electromechanics and Electrical Apparatuses”.  *Know:* methods of execution of experimental researches on the specialty “Electromechanics and Electrical Apparatuses”.  PC-2  *Have:* practical skills in processing experiment results on the specialty “Electromechanics and Electrical Apparatuses”.  *Be able to:* process experiment results on the specialty “Electromechanics and Electrical Apparatuses”.  *Know:* methods of processing experiment results on the specialty “Electromechanics and Electrical Apparatuses”.  PC-3  *Have:* practical skills in the development of mathematical models of general-purpose or special electromechanical converters or electrical apparatuses.  *Be able to:* develop mathematical models of general-purpose or special electromechanical converters or electrical apparatuses for performing researches.  *Know:* methods of mathematical modeling and mathematical models of general-purpose or special electromechanical converters or electrical apparatuses.  PC-4  *Have:* practical skills in the development of mathematical models and algorithms for solving tasks in the field of the scientific specialty.  *Be able to:* develop mathematical models and algorithms for solving tasks in the field of the scientific specialty.  *Know:* mathematical models and algorithms for solving tasks in the field of the specialty.  PC-5  *Have:* practical skills in the use of modern software packages for solving tasks of the scientific specialty.  *Be able to:* use modern software packages for solving tasks of the scientific specialty.  *Know:* limitations of the field of application of modern software packages for solving interconnected tasks of the scientific specialty.  PC-6  *Have:* practical skills in collection, processing, analysis and systematization of the information on the research topic, selection of methods and means of research task solving.  *Be able to:* perform collection, processing, analysis and systematization of the information on the research topic, select methods and means of research task solving.  *Know:* methods and means of research task solving.  PC-7  *Have:* practical skills in interpretation of research results with the purpose of composition of practical recommendations on the use of obtained results of research tasks.  *Be able to*: perform interpretation of research results with the purpose of composition of practical recommendations on the use of obtained results of research tasks.  *Know:* modern problems of electromechanics and electrical apparatuses. |

2. CONTENT OF WORKS ON THE EXECUTION OF RESEARCHES

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| --- | --- | --- | --- |
| Item No. | **Type** | Stages (sections) | Content of individual researches |
| 1. | Theoretical researches on the topic of the qualifying scientific work (dissertation)  Theoretical researches on the topic of the qualifying scientific work (dissertation) | *1. Preparatory* | *1. Safety induction training.*  *2. Studying of scientific and technical literature on the topic of the qualifying scientific work (dissertation).*  *3. Development of mathematical models on the topic of the qualifying scientific work (dissertation).*  *4. Testing and debugging of mathematical models* *on the topic of the qualifying scientific work (dissertation).* |
| *2. Main stage* | *1. Mathematical modeling on the topic of the qualifying scientific work (dissertation).*  *2. Studying of scientific and technical literature on the topic of the qualifying scientific work (dissertation).*  *3. Guidance for the execution of theoretical researches of bachelors and/or masters* |
| *3. Report preparation* | *1. Report preparation and protection*  *2. Preparation of report results for the publication.* |
| 2. | Experimental researches on the topic of the qualifying scientific work (dissertation) | *1. Preparatory* | ***1.****Safety induction training.*  *2. Studying of test benches of the measuring equipment.*  *3. Development and agreement of the experimental research execution program on the topic of the qualifying scientific work (dissertation).* |
| *2. Main stage* | *1. Execution of experimental researches on the topic of the qualifying scientific work (dissertation).*  *2. Processing of obtained results. Protocols drawing up.* |
| *3. Report preparation* | *1. Report preparation and protection*  *2. Preparation of report results for the publication.* |

**4. FUND OF ASSESSMENT MEANS FOR THE EXECUTION OF THE CURRENT AND MIDTERM ASSESSMENT ON THE COURSE IN THE DISCIPLINE**

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| **Exemplary topics of control activities on the current and interim attestation** |
| 1. Justify the necessity of the research execution for the preparation of the qualifying scientific work (dissertation).  2. Justify the selection of applied research methods.  3. Justify the truthfulness and novelty of obtained research results.  4. Justify the possibility and applicability of obtained research results. |
| ***Exemplary topic, objectives and tasks of researches are determined individually, agreed with the scientific adviser and entered into the individual plan of the post-graduate student.*** |

**5. METHODOLOGICAL AND INFORMATIONAL SUPPORT OF PRACTICUMS**

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| **Researches for the preparation of the qualifying scientific work (dissertation)** | |
| Main literature | |
| The list of the main literature on the topic of researches is composed individually by the post-graduate student upon results of search in the zonal scientific library of the UrFU, other libraries and the patent search. | |
| Supplementary literature | |
| The list of the supplementary literature on the topic of researches is composed individually by the post-graduate student upon results of search in the zonal scientific library of the UrFU, other libraries. | |
| Guidance papers | |
| Safety manuals | |
| Software | |
| 1. *NI LabView;*  2. *MathCAD;*  3. *Matlab;*  and any other licensed software available for the downloading from the web-site of the UrFU IT-office via the link and demonstration and free software, provided by developers in the free-access mode in the Internet (*ANSYS student, FEMM, Matlab* etc.) | |
| Data bases, information and reference and search systems | |
| *The list of data bases, information and reference and search systems is given on the web-site of the zonal scientific library of the UrFU* | |
| **Electronic educational resources** | |
| *not used* | *not used* |