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

DISCIPLINE WORK PROGRAM

**GENERAL ISSUES OF THE ELECTROMECHANICAL ENERGY CONVERSION**

|  |  |
| --- | --- |
| **List of information on the course work program**  | **Registration details** |
| **Educational program**Electromechanics and Electrical Apparatuses | **EP code**13.06.01/05.01Curriculum 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 |
| **FSES HE** | **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 expandeddd. April 30, 2015 |

**Ekaterinburg, 2018**

# GENERAL CHARACTERISTICS OF THE “GENERAL ISSUES OF THE ELECTROMECHANICAL ENERGY CONVERSION” DISCIPLINE

##  Annotation of the “General issues of the electromechanical energy conversion” course content

The *“General issues of the electromechanical energy conversion”* disciplineconsidersgeneral issues of the electromechanical energy conversion.

The*“General issues of the electromechanical energy conversion”* discipline is included into a variable part of the educational program and is an elective discipline: “General issues of electromechanical and electromagnetic energy conversion” or “Special electromechanical and electromagnetic transformers”.

The discipline considers processes of the energy conversion in electromechanical transformers and electromagnetic devices (transformer equipment) with regard to the nonlinearity and anisotropy of properties of magnetic materials, design peculiarities (even, uneven, discrete distribution of magnetic masses and current densities in space); design and new manufacturing methods of electromagnetic and electromechanical transformers.

**1.2.** **Language of the program implementation –** Russian.

## 1.3. Anticipated results of the program implementation

The result of the program learning consists in the development of the following competences:

As a result of the course learning, the postgraduate student has to:

* Universal Competences (UC) in accordance with FSES of HE:
1. ability to critically analyze and appraise modern scientific achievements, generate new ideas when solving research and practical tasks, including tasks in interdisciplinary areas (UC-1);
2. 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 history and science philosophy (UC -2);
3. readiness to participate in Russian and international research groups on solving scientific and research tasks (UC -3);
4. readiness to use modern methods and technologies of scientific communication in a state and foreign language (UC -4);
5. ability to follow ethical standards in professional activities (UC -5);
6. ability to plan and solve tasks of own professional and individual development (UC-6).
* General Professional Competences (GPC) in accordance with FSES of HE:
1. skills in the methodology of theoretical and experimental researches in the field of culture (GPC-1);
2. skills in the culture of scientific research, including the use of latest information and communication technologies (GPC -2);
3. ability to develop new research methods and use them in an individual research activities in the area of culture and education with due regard to the rules of the copyright compliance policy (GPC -3);
4. readiness to organize work of a research group in in the field of culture (GPC -4);
5. readiness for the teaching activity according to main educational programs of the higher education (GPC -5);
* Professional Competences (PC) for the studying specialty “Electromechanics and electrical devices” (code of the scientific specialty 05.09.01):
1. Ability to plan and perform experimental researches in the field of the scientific specialty (PC-1);
2. Ability to process experiment results in the field of the scientific specialty (PC-2);
3. Ability to develop mathematical models of general-purpose or special electromechanical converters or electrical apparatuses (PC-3);
4. Ability to develop mathematical models and algorithms for solving tasks of the scientific specialty (PC -4);
5. Ability to use modern software packages for solving tasks of the scientific specialty (PC -5);
6. Ability to perform collection, processing, analysis and systematization of the information on the research topic, select methods and means for the research task (PC ‑6);
7. Ability to interpret results of scientific researches in order to develop practical recommendations on the use of obtained results (PC ‑7);
8. Ability and readiness for teaching activities on main educational programs in the field of professional education in educational institutions for higher education, professional educational organizations for the scientific specialty 05.09.01 “Electromechanics and electrical apparatuses” (PC -8).

## Discipline scope

|  |  |  |  |
| --- | --- | --- | --- |
| **Item No.** | **Types of academic activities** | **Discipline scope** | **Distribution of the discipline scope by semesters (hours)** |
| **Total hours** | **Incl. Contact work (hour)\*** | 5 |
| **1.** | **In-class studies** | **4** | **4** | **4** |
| **2.** | Lectures | 4 | 4 | 4 |
| **3.** | Practical studies | 0 | 0 | 0 |
| **4.** | Laboratory works | 0 | 0 | 0 |
| **5.** | **Students' individual work, including all types of the current assessment** | **104** | **0,6** | **104** |
| **6.** | **Midterm assessment** | **4** | **0,25** | **Pass/Fail ex. (4)** |
| **7.** | **Total volume on the plan of study, hours** | 108 | 4,85 | 108 |
| **8.** | **Total volume on the plan of study, c.p.** | 3 | 0,045 | 3 |

# \*Contact work comprises:

# In item No. 2,3,4 - number of hours that is equal to the scope of an appropriate type of training;

# In item 5 – number of hours that is equal to the total amount of time, assigned to the teacher for consultations in group (15% of total in-class studies).

In item 6 – number of hours that is equal to the total amount of time, assigned to the teacher for an appropriate time of the midterm assessment of one post-graduate student.

# DISCIPLINE CONTENT

##

|  |  |  |
| --- | --- | --- |
| **Code of section, topic** | **Course section, topic** | **Content** |
| **1** | General issues of electromagnetic energy conversion | Processes of the energy conversion in electromagnetic devices (transformer equipment) with regard to the nonlinearity and anisotropy of properties of magnetic materials, design peculiarities (even, uneven, discrete distribution of magnetic masses and current densities in space). |
| **2** | General issues of electromechanical energy conversion | Processes of the energy conversion in electromechanical devices (transformer equipment) with regard to the nonlinearity and anisotropy of properties of magnetic materials, design peculiarities (even, uneven, discrete distribution of magnetic masses and current densities in space). |

1. **COURSE SCHEDULING**

## Distribution of teaching load and individual work activities by discipline sections

|  |  |
| --- | --- |
|  | Discipline scope (credit points.):3 |
| **Discipline section** | **In-class studies (hours)**  | **Discipline section** |
| Section, topic code | Section, topic code | **Total per section, topic (hours)** | Section, topic code | Section, topic code | **Total per section, topic (hours)** | Section, topic code | Section, topic code | **Total per section, topic (hours)** | Section, topic code | Section, topic code | **Total per section, topic (hours)** | Section, topic code |
| **Total** | Lecture | Practical seminar study | Laboratory work | Scientific seminar, seminar-conference, colloqium | **Total**  | Homework | Graphical work | Report, essay, тcreative work | Ind. or group project | Translation of foreign literature | Calculations, development of the software product | Calculation and graphic works | **Total** | Lecture | Practical seminar study | Laboratory work | Scientific seminar, seminar-conference, colloquium  | Pass-fail exam with examination | Pass-fail exam without examination | Examination | Integrated assessment of results of learning of module disciplines  | Integrated examination on the module |
| 1 | General issues of electromagnetic energy conversion | 50,4 | 2 | 2 |  |  | 48,4 | 0,4 | 0,4 |  |  |  | 48 |  |  | 4 |  |  |  |  |  |  |  | 0,0 |  |  |
| 2 | General issues of electromechanical energy conversion | 53,6 | 2 | 2 |  |  | 51,6 | 0,4 | 0,4 |  |  |  | 51,2 | 1 |  | 4 |  |  |  |  |  |  |  | 0,0 |  |  |
|  | **Total (hours) without midterm assessment:** | **104,0** | **4** | **4** | **0** | **0** | **100,0** | **0,8** | **0,8** | **0** | **0** | **0** | **99,2** | **3,2** | **0** | **96** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0,0** | **0** | **0** |
|  | **Total per discipline (hours):** | **108** | **4** |  | **104** | Incl. midterm assessment | **4** | **0** | **0** | **0** |
| \*total volume in hours per activity is indicated in the line Total (hours) without midterm assessment |

# ARRANGEMENT OF PRACTICAL STUDIES, INDIVIDUAL WORK IN THE DISCIPLINE

## Laboratory works

## Not applicable

## Practical studies

## Not applicable

**4.3. Exemplary topic of the individual work**

*Not applicable*

### Exemplary list of report topics (essays, creative works)

1) Modern methods of determination of powers in electromagnetic converters (transformer equipment).

2) Modern methods of determination of powers in electromechanical converters

3) Classification of modern electromagnetic energy converters.

4) Classification of modern electromechanical energy converters.

5) Analysis of design of electromagnetic energy converters (transformer equipment).

6) Analysis of design of electromechanical energy converters.

7) Use of new engineering processes for the manufacturing of electromagnetic energy converters (transformer equipment).

8) Use of new engineering processes for the manufacturing of electromechanical energy converters.

**4.3.3 Exemplary topics of individual or group projects**

## Not applicable

* + 1. **Exemplary topics of control works**

## Not applicable

### Exemplary topics of colloquiums

## Not applicable

### Exemplary topics of calculation works

1. **CORRELATION OF DISCIPLINE SECTIONS, TOPICS AND USED TEACHING TECHNOLOGOES**

# *[mark with asterisk or another symbol used training technologies by discipline sections and topics]*

|  |  |  |
| --- | --- | --- |
| **Code of a discipline, discipline topic** | **Active methods of teaching** | **Remote educational technologies and electronic teaching** |
| Project work | Case-analysis | Business games | Problem-based learning | Team work | Other (practical study) | Network-based education courses | Virtual workshops and simulators | Webinars and videoconferences | Asynchronous web-conferences and seminars | Collaborative work and content development | Others (indicate) |
| Р1 |  |  |  | \* |  |  |  |  | \* | \* |  |  |
| Р2 |  |  |  | \* |  |  |  |  | \* | \* |  |  |

# 6. FUND OF ASSESSMENT MEANS FOR THE EXECUTION OF THE CURRENT AND MIDTERM ASSESSMENT ON THE COURSE IN THE DISCIPLINE (Appendix 1)

# 7. METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE COURSE

## 7.1. Recommended literature

## 7.1.1. Main literature

1. A.V. Ivanov-Smolensky. Electrical Machines: textbook for students of higher education institutions, pursuing a specialist's degree in “Electrotechnics, Electromechanics and Electrotechnologies”: in 2 vol. V. 1 / A.V. Ivanov-Smolensky. 3rd ed., ster. Moscow: MPEI, 2006. 652 p.
2. A.V. Ivanov-Smolensky. Electrical Machines: textbook for students of higher education institutions, pursuing a specialist's degree in “Electrotechnics, Electromechanics and Electrotechnologies”: in 2 vol. V. 1 / A.V. Ivanov-Smolensky. 2nd ed., rev. and enl. М.: MPEI publ.house, 2004. 652 p.
3. A.V. Ivanov-Smolensky. Electrical Machines: textbook for students of higher education institutions, pursuing a specialist's degree in “Electrotechnics, Electromechanics and Electrotechnologies”: in 2 vol. V. 2 / A.V. Ivanov-Smolensky. 2nd ed., rev. and enl. М.: Vyshaya Shkola, 2004. 532 p.
4. A.V. Ivanov-Smolensky. Electromagnetic Forces and Energy Conversion in Electrical Machines: textbook for students of higher education institutions, pursuing a specialist's degree in "Electromechanics " / A.V. Ivanov-Smolensky.— М.: Vyshaya Shkola, 1989 .— 311 p. : il. ; 21 sm .— allowed as study guide .— ISBN 5-06-000103-2 : 0.95. (Inv. No.: 8531 - 6 cop.; Inv. No.: 1038319 – 1 cop.).
5. A.I. Voldek Electrical Machines. Introduction to Electromechanics. Direct-Current Machines and Transformers: textbook for students of higher education institutions, pursuing a specialist’s degree in "Electrotechnics, Electromechanics and Electrotechnologies" and "Electrical Power Engineering" / A.I. Voldek, V.V. Popov. Moscow; Saint-Petersburg; Nizhny Novgorod [et al.]: Piter, 2008. 320 p.
6. A.I. Voldek Electrical Machines. Introduction to Electromechanics. Direct-Current Machines and Transformers: textbook for students of higher education institutions, pursuing a specialist’s degree in "Electrotechnics, Electromechanics and Electrotechnologies" and "Electrical Power Engineering" / A.I. Voldek, V.V. Popov. Moscow; Saint-Petersburg; Nizhny Novgorod [et al.]: Piter, 2007. 320 p.
7. A.I. Voldek Electrical Machines. Alternating-Current Machines: textbook for students of higher education institutions pursuing a specialist’s degree in "Electrotechnics, Electromechanics and Electrotechnologies" and "Electrical power engineering" / A.I. Voldek, V.V. Popov. Moscow; Saint-Petersburg; Nizhny Novgorod [et al.]: Piter, 2008. 350 p.
8. A.I. Voldek Electrical Machines. Alternating-Current Machines: textbook for students of higher education institutions pursuing a specialist’s degree in "Electrotechnics, Electromechanics and Electrotechnologies" and "Electrical power engineering" / A.I. Voldek, V.V. Popov. Moscow; Saint-Petersburg; Nizhny Novgorod [et al.]: Piter, 2007. 350 p.
9. I.P. Kopylov Electrical Machines: textbook for students of higher education specialties, related to electrical energy / I.P. Kopylov. Ed. 6-е, ster. M.: Vyshaya Shkola, 2009. 607 p.
10. I.P. Kopylov Electrical Machines: textbook for students higher education specialties, related to electromechanics and electrical energy / I.P. Kopylov. Ed. 5-е, ster. М.: Vyshaya Shkola, 2006. 607 p.
11. Pavel Michailovich Tikhomirov. Transformer Design: textbook for students higher education specialties, related to electromechanics and electrical energy  / P.M. Tikhomirov.— Ed. 7-е .— Moscow: URSS : LENAND .— 527 p.
12. Pavel Michailovich Tikhomirov. Calculation of a Transformer: textbook for students higher education specialties, related to electromechanics and electrical energy  / P.M. Tikhomirov.— Ed. 6-е rev. and enl. — Minsk: Vyshaya Shkola А, 2011 .— 528 p.
13. Design of Electrical Machines : textbook for students higher education specialties, related to electromechanics and electrical energy  / [I.P. Kopylov, B.K. Klokov, V.P. Morozkin, B.F. Tokarev] ; under the editorship of I.P. Kopylov.— 4-е Ed., rev. and enl. — Moscow : Urayt, 2011 .— 767 p.
14. Oscar Davidovich Goldberg. Electromechanics: textbook for students of higher education institutions pursuing a specialist’s degree in 140200 "Electrical power engineering" / O.D. Goldberg, S.P. Khelemskaya; under the editorship of O.D. Goldberg .— 2-е Ed., corr. — Moscow : Akademia, 2010 .— 512 p.
15. [M.P.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%9A%D0%BE%D1%81%D1%82%D0%B5%D0%BD%D0%BA%D0%BE,%20%D0%9C.%20%D0%9F.%5B1,1004,3,101%5D&LANG=rus) Kostenko Electrical Machines. 2. Alternating-Current Machines / [M.P.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%9A%D0%BE%D1%81%D1%82%D0%B5%D0%BD%D0%BA%D0%BE,%20%D0%9C.%20%D0%9F.%5B1,1004,3,101%5D&LANG=rus) Kostenko; L.M. Piotrovsky. — Ed. 3-е, rev. and enl. — Leningrad : Energiya, 1973 .— 648 p. — <URL:<http://biblioclub.ru/index.php?page=book&id=450046>>.
16. [M.P.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%9A%D0%BE%D1%81%D1%82%D0%B5%D0%BD%D0%BA%D0%BE,%20%D0%9C.%20%D0%9F.%5B1,1004,3,101%5D&LANG=rus) Kostenko Electrical Machines. 1. Direct-Current Machines. Transformers / [M.P.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%9A%D0%BE%D1%81%D1%82%D0%B5%D0%BD%D0%BA%D0%BE,%20%D0%9C.%20%D0%9F.%5B1,1004,3,101%5D&LANG=rus) Kostenko; L.M. Piotrovsky.— Ed. 3-е, rev. and enl. — Leningrad : Energiya, 1972 .— 544 p. — <URL:<http://biblioclub.ru/index.php?page=book&id=450047>>.
17. [N.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A9%D0%B5%D0%B3%D0%BB%D0%BE%D0%B2,%20%D0%9D.%20%D0%92.%5B1,1004,3,101%5D&LANG=rus)V. Scheglov Modern Types of Insulation : study guide. 4. Insulation of power transformers / [N.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A9%D0%B5%D0%B3%D0%BB%D0%BE%D0%B2,%20%D0%9D.%20%D0%92.%5B1,1004,3,101%5D&LANG=rus)V. Scheglov.— Novosibirsk : NGTU, 2011 .— 88 p. — ISBN 978-5-7782-1841-3 .— <URL:<http://biblioclub.ru/index.php?page=book&id=228782>>.
18. [N.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A9%D0%B5%D0%B3%D0%BB%D0%BE%D0%B2,%20%D0%9D.%20%D0%92.%5B1,1004,3,101%5D&LANG=rus)V. Scheglov Modern types of insulation : study guide. 5. Insulation of High-Voltage Electrical Machines / [N.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A9%D0%B5%D0%B3%D0%BB%D0%BE%D0%B2,%20%D0%9D.%20%D0%92.%5B1,1004,3,101%5D&LANG=rus)V. Scheglov.— Novosibirsk : NGTU, 2013 .— 87 p. — ISBN 978-5-7782-2166-6 .— <URL:<http://biblioclub.ru/index.php?page=book&id=228783>>.
19. [G.A.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A8%D0%B0%D0%BD%D1%88%D1%83%D1%80%D0%BE%D0%B2,%20%D0%93.%20%D0%90.%5B1,1004,3,101%5D&LANG=rus) Shanshurov Special Electrical Machines : Assessment of Quality of Alternating-Current Machine Windings at the Design Stage : study guide / [G.A.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A8%D0%B0%D0%BD%D1%88%D1%83%D1%80%D0%BE%D0%B2,%20%D0%93.%20%D0%90.%5B1,1004,3,101%5D&LANG=rus) Shanshurov ; T.V. Druzhinina ; A.Y. Budnikova.— Novosibirsk : NGTU, 2015 .— 40 p. — ISBN 978‑5‑7782‑2667-8 .— <URL:<http://biblioclub.ru/index.php?page=book&id=438452>>.
20. [R. Richter.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A0%D0%B8%D1%85%D1%82%D0%B5%D1%80,%20%D0%A0.%5B1,1004,3,101%5D&LANG=rus) Electrical Machines. Direct-Current Machines / R. Richter.— М.|Л. : ONTI NKTP USSR, 1935 .— 602 p. — ISBN 978-5-4458-0562-5 .— <URL:<http://biblioclub.ru/index.php?page=book&id=117331>>.
21. [R. Richter](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A0%D0%B8%D1%85%D1%82%D0%B5%D1%80,%20%D0%A0.%5B1,1004,3,101%5D&LANG=rus) Electrical Machines / R. Richter.— М.|L.: ONTI NKTP USSR, 1936 .— 689 p. — ISBN 978-5-4458-0583-0 .— <URL:<http://biblioclub.ru/index.php?page=book&id=117332>>.
22. [R. Richter](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A0%D0%B8%D1%85%D1%82%D0%B5%D1%80,%20%D0%A0.%5B1,1004,3,101%5D&LANG=rus) Electrical Machines / R. Richter.— М.|L.: ONTI NKTP USSR, 1935 .— 294 p. — ISBN 978-5-4458-0584-7 .— <URL:<http://biblioclub.ru/index.php?page=book&id=117333>>.
23. [R. Richter](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%A0%D0%B8%D1%85%D1%82%D0%B5%D1%80,%20%D0%A0.%5B1,1004,3,101%5D&LANG=rus) Electrical Machines / R. Richter.— М.|L.: State United Scientific and Technical Publishing House. Editorial office for power engineering literature, 1939 .— 472 p. — ISBN 978-5-4458-4076-3 .— <URL:<http://biblioclub.ru/index.php?page=book&id=210832>>.
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25. N.R. Siunov Electrical Machines (special course): a compendium of lectures for extramural students / .— Printed publ. — , 1980 .— N.R. Siunov; UPI. - Sverdlovsk, 1980. — in the UrFU copropate network.— <URL:<http://study.urfu.ru/view/Aid_view.aspx?AidId=2052>>.
26. [N.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%95%D1%80%D0%BC%D0%BE%D0%BB%D0%B8%D0%BD,%20%D0%9D.%20%D0%9F.%5B1,1004,3,101%5D&LANG=rus)P. Ermolin How to Design a Small-Power Transformer / [N.](http://212.193.82.25/cgi/zgate.exe?ACTION=follow&SESSION_ID=4816&TERM=%D0%95%D1%80%D0%BC%D0%BE%D0%BB%D0%B8%D0%BD,%20%D0%9D.%20%D0%9F.%5B1,1004,3,101%5D&LANG=rus)P. Ermolin.— М.|L.: State energy publishing house, 1961 .— 50 p. — (Electrician’s Library. Issue 33) .— <URL:<http://biblioclub.ru/index.php?page=book&id=117934>>.
27. Production of Electrical Machines and Transformers: study guide / .— Printed publ. — , 1978 .— Production of Electrical Machines and Transformers: study guide; M.F. Antipov; UPI .— in the UrFU copropate network .— <URL:<http://study.urfu.ru/view/Aid_view.aspx?AidId=3397>>.
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## 7.2. Guidance papers

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## 7.3.Software

***LabVIEW software development environment***;

***FEMM 4.2*** *(http://www.femm.info/wiki/License)* ;

***Scilab*** *(http://www.scilab.org/scilab/about)* ;

***PTC Mathcad Express*** *— free software for engineering calculations (http://ru.ptp.com/product/mathcad/download-free-trial)*.

For the individual work post-graduate students can use student versions of the software, downloaded from web-pages of developers:

[*National Instruments*](http://russia.ni.com/academic)(*U.S.A.*)- [***Free LabVIEW Student Edition for 6 months***](https://decibel.ni.com/content/docs/DOC-30610)(*http://www.ni.com/labviewse/,*  *https://decibel.ni.com/content/docs/DOC-30610);*

*MathWorks****®*** (*U.S.A.*) *-* ***MATLAB***

[student trial version](student%20trial%20version%20)

*(http://matlab.ru/education/student-trial)* ;

*ANSYS, Inp.*(*U.S.A.) -* ***ANSYS® Student*** *(*[*http://www.ansys.com/Industries/Academic/Student+Product/Product+Download*](http://www.ansys.com/Industries/Academic/Student%2BProduct/Product%2BDownload)*)*.

Example of installation of the ***ANSYS® Student*** student’s license is given on the web-site [*http://www.ansys.com/Industries/Academic/Student+Product/Installation+Help*](http://www.ansys.com/Industries/Academic/Student%2BProduct/Installation%2BHelp).

## 7.4 Data bases, information and reference and search systems

[*http://study.urfu.ru*](http://study.ustu.ru) Portal of information and information education resources of the UrFU.

*http://lib.urfu.ru/course/view.php?id=169* Zonal research library of the UrFU

[*http://www.ansys.com*](http://www.ansys.ru) *ANSYS – Simulation Driven Product Development*

[*http://www.femm.info/wiki/Documentation/*](http://www.femm.info/wiki/Documentation/) [*Finite Element Method Magnetics*](http://www.femm.info/wiki/HomePage)*: Documentation*

*http://ru.ptp.com/product/mathcad/resources* *PTC Mathcad Express* Resources

[*http://www.exponenta.ru*](http://www.exponenta.ru) Educational mathematical web-site [*Exponenta.ru*](http://www.exponenta.ru)

## 7.5. Electronic educational resources

*Not used*

**Appendix 1**

**To the discipline work program**

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

**8.1. CRITERIA FOR THE ASSESSMENT OF RESULTS OF CONTROL ACTIVITIES OF THE CURRENT AND MIDTERM ASSESSMENT ON THE DISCIPLINE**

 **Criteria for the assessment of post-graduate student’s achievement, accepted at the academic department, are used. The system of assessment criteria is based on three levels of learning the competence components: threshold, advanced, high.**

|  |  |
| --- | --- |
| **Competence components** | **Signs of level of competence components learning**  |
| **threshold** | **advanced** | **high** |
| **Knowledge**  | The post-graduate student shows the knowledge- acquaintance, the knowledge-copy: he recognizes subjects, phenomena and definitions, can find differences between them, shows the knowledge of information sources, can perform knowledge reproductive actions by reproduction and use of information on his own.  | The post-graduate student shows analytical knowledge: reproduces and understands obtained knowledge , includes them into this or that classification group, systematize them by himself, establishes interconnections between them, fruitfully uses them in familiar situations. | The post-graduate student can retrieve knowledge from the environment, creatively use them for making decisions in new and non-conventional situations.  |
| **Skills** | The post-graduate student can correctly perform prescribed actions as per the instruction, algorithm ina familiar situation, act by himself when solving typical tasks that require to make choice from the range of known methods, in a predictably changing situation | The post-graduate student can perform actions by himself (approaches, operations) related to solving non-conventional tasks that require to make choice on the basis of a combination of known methods, in a predictably changing situation | The post-graduate student can perform actions by himself related to solving research tasks, demonstrates creative appliance of skills (technologies) |
| **Personal qualities** | The post-graduate student has low motivation for the learning activity, shows indifferent, irresponsible attitude to the learning process, assigned task  | The post-graduate student has obvious motivation for the learning activity, demonstrates positive attitude to the learning process and further labor activity, is active.  | The post-graduate student has obvious motivation for the studying and working activity, is insistent and passionate, hard-working, self-dependent, creative.  |

**8.2. ASSESSMENT MEANS FOR THE EXECUTION OF THE CURRENT AND MIDTERM ASSESSMENT IN THE DISCIPLINE**

**8.2.1. Exemplary tasks for small control works during classes**

 *Not applicable*

**8.2.2. Exemplary control tasks during classes**

*Not applicable*

**8.2.3. Exemplary control cases**

*Not applicable*

**8.2.4.** **List of exemplary questions for the pass/fail exam**

1) Modern methods of determination of powers in electromagnetic converters (transformer equipment).

2) Modern methods of determination of powers in electromechanical converters

3) Classification of modern electromagnetic energy converters.

4) Classification of modern electromechanical energy converters.

5) Analysis of design of electromagnetic energy converters (transformer equipment).

6) Analysis of design of electromechanical energy converters.

7) Use of new engineering processes for the manufacturing of electromagnetic energy converters (transformer equipment).

8) Use of new engineering processes for the manufacturing of electromechanical energy converters.

**8.2.5. List of exemplary questions for the examination**

*Not applicable*