**MODERN METHODS OF INCREASING THE EFFICIENCY AND RELIABILITY OF TURBINE PLANTS**

# GENERAL DESCRIPTION OF THE DISCIPLINE

The work programme of the discipline is compiled according to the Federal State Higher Professional Education Standards

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| --- | --- | --- | --- |
| Code of the field of study and attainment level | Field of study | Details of the order of the Ministry of Education and Science of the Russian Federation on approval and commissioning of the Federal State Higher Educational Standard | |
| Date | **Number of order** |
| 13.06.01 | Thermal Engineering and Electrical Engineering | 30 July 2014 | 878 |

## Abstract of the discipline content

The discipline falls under the post-graduate programme. The main goal of studying the discipline is the creation of a set of basic knowledge and practical skills for postgraduates, which allow analysing the power engineering science and production problems in tune with the times (meeting up-to-date requirements) in order to improve it.

## Planned results of mastering the discipline

As a result of mastering the discipline, a postgraduate student should obtain the competencies as follows:

* the readiness to engage in the work of Russian and international research teams to tackle academic problems (UC-3);
* the readiness to use contemporary methods and technologies of scientific communication in the state and foreign languages (UC-4).
* the ability to plan and accomplish the professional and personal development tasks (UC-6);
* the ability to critically analyse and evaluate current scientific achievements, generate new ideas for solving research and practical problems, including in interdisciplinary areas (UC-1);
* the ability to scientifically justify the assessment of new solutions in the field of building and modelling machines, drives, equipment, process systems and dedicated machine-building equipment as well as the process equipment for production (GPC-1);
* the ability to formulate and solve non-standard problems of mathematical, physical, engineering, technological and electrical engineering nature in the design, manufacture and operation of new equipment (GPC-2);
* the ability to form and reasonably present scientific hypotheses (GPC-3);
* the ability to take the initiative in the field of research, also in situations of the technical and economic risk, with awareness of the responsibility for decisions (GPC-4);
* the ability to plan and conduct experimental studies with subsequent adequate evaluation of the results obtained (GPC-5);
* the ability to develop physical and mathematical models of objects in the design of new machines, automatic and automated control systems for the process equipment and processes in power engineering (PC-1);
* the ability to conduct the kinematic and dynamic analysis and synthesis of modern machine-building, robotic, information-measuring and diagnostic systems, the system of automation and control of the process equipment and processes in power engineering (PC-2);
* the ability to develop technical tasks and feasibility studies for the creation of science-intensive products for the power engineering industry, the provision of production and engineering processes, and the creation of quality indicators for products and processes in accordance with the existing national and international regulatory framework (PС-3)
* the knowledge of the software of modern production systems as well as programming languages in the design and process-related preparation of production, automated product design tools as well as production and engineering processes and systems (PC-4);
* the readiness to use modern achievements of science and advanced technologies in the turbomachinery and turbine unit R&D (PC-7);
* the ability to interpret the results in order to draw up practical recommendations on the future use of research data (PC-8);

As a result of mastering the discipline, a post-graduate student should:

Know:

- the areas of technical progress in heat-and-power engineering,

- the heat-and-power engineering and turbine unit prospects and areas,

- the current trends and methods for increasing the efficiency, reliability and safety of the heat-and-power machinery,

- the basis for modern methods of a technical and economic analysis in relation to the heat-and-power engineering challenges.

Be able:

- to analyse the information received from heat-and-power facilities and take reasonable technical decisions based on it;

- to determine possible areas for improving the heat-and-power machinery at various stages of their life cycle.

Demonstrate skills and experience:

- in the practical activities for determining the effectiveness of certain machinery;

## Discipline scope

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| --- | --- | --- |
| **Types of the educational work, forms of control** | **Hours, total** | **Study terms,**  **number** |
| **2** |
| In-class learning, hours | **4** | **4** |
| Lectures, hours | 4 | 4 |
| Practical exercises, hours | - | - |
| Laboratory-based work, hours | - | - |
| Self-guided work of students, hours | **104** | **104** |
| Interim attestations | **-** | **Test, 4** |
| Total work intensity according to the curriculum, hours | 108 | |
| Total work intensity according to the curriculum, credits | 3 | |

# DISCIPLINE CONTENT

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| --- | --- | --- |
| **Code of section, topic** | **Discipline section, topic\*** | **Content** |
| **Р1** | Energy industry and power engineering in Russia and in the world: the state and development options | The global and domestic market of power equipment producers and consumers. The key power equipment research and design centres in Russia and globally. Trends in the development of energy systems in various countries, in Russia. The state influence in the energy sector and power engineering. The perspectives and reserves of energy saving in Russia |
| **Р2** | Monitoring the state and the main power engineering industry facility diagnostics. | The technical and economic indicators of the power equipment: goals, tasks, history of development, the impact on the formation of tariffs on the heat and electricity released; encoding equipment  Monitoring the condition and diagnosing the equipment of a steam turbine plant, such as a steam turbine, a condensation plant, a turbine regeneration system, a water heater, evaporators, deaerators etc. (at the level of process sub-systems of steam turbine plants (STP)) |
| **Р3** | Increase in the efficiency and reliability of heat exchangers of steam turbine plants | Technical characteristics and typical designs of STP heat exchangers: an analysis of the capabilities of methods for improving specific heat exchangers taking into account the modes (parameters) of their operation and design.  Increase in the thermal efficiency of heat exchangers: an experimental research into physical processes occurring in heat exchangers with a heat exchange surface from profile twisted tubes, other ways of increasing the heat transfer intensity, and the influence of various technological and operational factors on the performances of apparatuses. An increase in the reliability of heat exchangers in terms of corrosion resistance of tube material and their vibration characteristics. Process-related measures that improve the reliability of heat exchangers.  Methods for calculating heat exchangers. The influence of factors on the effectiveness and reliability of their operation.  Operational monitoring the technical condition of heat exchangers for STP.  Development of highly efficient heat exchangers. |
| **Р4** | Modern thermal engines and installations. | Features of the operation of thermal engines at TPPs, nuclear power plants, condensation plants and in the industry. Comparative technical and economic indicators, efficiency, conditional fuel consumption, environmental safety. |
| **Р5** | Modern electrohydraulic systems for the regulation and protection (EHSRP) of steam turbines. | - EHSRP Need to switch to EHSRP of steam turbines in the present context; structure of EHSRP; EHSRP functions; typical EHSRP nodes; results of EHSRP implementation; - economic efficiency of EHSRP; - mathematical modeling of EHSRP; prospects for further development of EHSRP |

**3. PROCEDURES FOR THE LEARNING OUTCOME MONITORING AND EVALUATION**

The discipline provides for the final attestation in the form of a test.

1. Milestones for the creation and development of thermal engines (TE); field of application.

2. TE life cycle: the main stages, their mutual influence.

3. Features of development, manufacturing (production) and operation of TE.

4. Features of the operation of TEs at TPPs, NPPs, CS and in industry.

5. Comparative technical and economic indicators of TE.

6. Change in the electricity generation volumes and indicators with all types of power plants.

7. Key producers of power equipment in the Russian Federation; the ranges of equipment sizes.

8. Most recent power engineering technologies.

9. Ways (methods) of the state influence on the efficiency and reliability of the energy sector and power engineering.

10. Perspectives and reserves of energy saving due to the improvement of the TE at all stages of their life cycle.

11. Monitoring, diagnostics, control: definitions and interrelation of concepts.

12. Structure of the technical and economic performances. Communication of the technical and economic performances and tariffs for energy types.

13. Methods for non-destructive testing of metals.

14. Methods for diagnosing the power equipment.

15. Monitoring the condition, diagnosis and basic malfunctions of the elements of a steam turbine plant: a turbine or one of the process subsystems of a STP.

16. What is the repair and how is it different from maintenance?

17. What are the main types of repair?

18. What are the two major repair strategies currently being implemented, and what is the difference?

19. What type of work involves the repair of the auxiliary heat exchange equipment?

20. List the main requirements for materials used to manufacture the auxiliary heat-exchange equipment of power plants?

21. EHSRP structure and functions.

22. EHSRP cost-effectiveness.

23. Prospects for further development of EHSRP.

**Databases, information, reference and search systems**

1. http://www.google.com and others.
2. The official website of the Ministry of Energy of the Russian Federation: http://minenergo.gov.ru
3. The official website of OAO Gazprom: http://www.gazprom.ru