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Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE
LUMUMBA
RUDN University

Academy of Engineering

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Automatic heat engine control

course title

Recommended by the Didactic Council for the Education Field of:

13.04.03. POWER ENGINEERING

field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:

Mechanical Engineering

higher education programme profile/specialisation title

1. The COURSE GOAL

The discipline "Automatic heat engine control" is included in the master's degree program "Mechanical Engineering" in the direction of 13.04.03 "Energy Engineering" and is studied in the 2nd semester of the 1st year. The discipline is implemented by the Basic Department of Energy Engineering. The discipline consists of 7 sections and 15 topics and is aimed at studying the basics of the theory of regulation and methods of designing elements of steam and gas turbines.

The purpose of mastering the discipline is to apply the theory of regulation in the design of nodes of regulating systems of steam and gas turbines, which will allow you to correctly identify ways to further improve these systems.

2. REQUIREMENTS FOR LEARNING OUTCOMES:

The following competences are formed in the study process.

Table 2.1. List of competences that students acquire during the course

Competence code	Competence descriptor	Competence formation indicators
GC-1	Ability to carry out a critical analysis of problematic situations based on a systematic approach, develop a strategy for action.	GC-1.1. Analyzes the problematic situation and decomposes it into separate tasks; GC-1.2. Develops a strategy for solving the task; GC-1.3. Forms possible solutions to problems.
GPC-1	Ability to formulate research goals and objectives, identify priorities for solving problems, and select evaluation criteria.	GPC-1.1. Formulates the goals and objectives of the study; GPC-1.2. Defines the sequence of problem solving GPC-1.3. Formulates the criteria for making a decision.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The subject refers to the variable component of (B1) block of the higher educational programme curriculum.

Within the higher education programme students also master other disciplines and internships that contribute to the achievement of the expected learning outcomes as results of the subject mastery

Table 3.1. The list of the higher education programme components that contribute to the achievement of the expected learning outcomes as the course results

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
GC-1	Ability to carry out a critical analysis of problematic situations based on a systematic approach, develop a strategy for action.	Philosophical issues of technical knowledge; Mathematical modeling of thermal processes; Systems of fuel supply for ICE**; Prospects for the use of alternative fuels in diesel engines**; Patenting;	Alternative Energy Sources;
GPC-1	Ability to formulate research goals and objectives, identify priorities for solving problems, and select evaluation criteria.	-	Alternative Energy Sources;

* - in accordance with the matrix of competencies and the SUP EP VO

4. WORKLOAD OF THE COURSE AND FORMS OF STUDY WORK

General workload of the course 5 credits, 180 hours. Table 4.1. Form of study work of EP HE

Type of academic activities		Total academic hours	Semester(s)			
			2			
<i>Contact academic hours</i>		83	83			
including:						
Lectures (LC)		34	34			
Lab works (LW)		17	17			
Seminars (workshops / tutorials) (S)		34	34			
<i>Self-studies academic hours</i>		68	68			
<i>Evaluation and assessment academic hours</i>		27	27			
<i>Course work / project, credits</i>		0	0			
Course workload	academic hours	180	180			
	credits	5	5			

5. CONTENT OF THE COURSE

Table 5.1. Content of the course

The title of the section of the discipline	Content of the section (topic)	Types of educational work*
Section 1 Static.	Angular velocity control. The speed controller. Direct regulation. The effect of insensitivity in the regulatory system.	LC, LR, SM, AW
	Indirect regulation. management mechanisms. Isodromic control system. Parallel operation of turbo generators. The influence of the control mechanism during parallel operation of the units.	LC, LR, SM, AW
	Frequency controllers. Regulation of turbines with back pressure. Pressure regulators. Regulation of turbines with steam extraction.	LC, LR, SM, AW
Section 2 Dynamics.	The equation of motion of the turbine rotor. The equation of motion of the speed controller. The equation of motion of direct regulation. Stability conditions.	LC, LR, SM, AW
	The influence of system parameters on its stability. The equation of motion of the servo motor. The influence of the isodrome on the work of regulation. The acceleration regulator. Turbine regulation with steam extraction. The volume equation. The effect of the intermediate volume in turbines without steam extraction.	LC, LR, SM, AW
	Structural analysis and synthesis of regulatory systems. The speed of the control systems. Changing the regulation setting. Testing of control systems.	LC, LR, SM, AW
Section 3 Turbine regulators.	Valve steam distribution. Steam forces on the regulatory authorities. Rotary diaphragms. Transfer mechanisms.	LC, LR, SM,

		AW
Section 4 Servos and spools.	Servomotors with a shut-off valve. Servomotors with a flowing spool. Dynamics of a servo motor with a flowing spool. Hydraulic springs.	LC, LR, SM, AW
	Valve control of servomotors. Spools. rotating spools and pistons. Self-centering pistons. Flat spools. Shut off the spool.	LC, LR, SM, AW
Section 5 Liquid supply to the control system.	Gear or screw pumps. Batteries. Centrifugal pumps. Injectors. Two-injector oil supply circuit.	LC, LR, SM, AW
	Calculation of the oil pump performance. Pumps with electric drive. Oil tanks. Filters.	LC, LR, SM, AW
Section 6 Regulators.	Mechanical speed controls. Hydraulic sensors. Pulse pressure pulsation. Angular velocity sensors. Pressure regulators.	LC, LR, SM, AW
	Static and dynamic characteristics. Speed and acceleration controls. Differentials. Pressure regulators and their derivatives.	LC, LR, SM, AW
Section 7 Protection of the turbine from excessive increase in angular velocity.	Stop valves. Servomotors of stop valves. Automatic safety devices. The effect of shaft vibration on the operation of the machine. Checking the security machine.	LC, LR, SM, AW
	Stop valve control system. A goldless protection system.	LC, SM, AW

* - LC – lecture, LR – laboratory work, SM – seminars; AW – Autonomous work

6. INTERNSHIP EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Technical Support Requirements

A type of aclassroom	Technical Support Requirements	Special equipment, software
For lectures	An auditorium for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multi-media presentations	Technical means: projector Epson EH- TW5300 (LCD, 1080p 1920 x 1080, 2200Lm, 35000:1, 2 x HDMI, MHL, экран Draper Bar-onet NTSC (3:4) 244/96(8) 152*203 MW
For seminars	Auditorium for seminar-type classes, group and individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and technical means of multimedia presentations	Computer class; technical equipment: personal computers, projection screen, multimedia projector, NEC NP-V302XG, Internet access. Software: Microsoft products (OS, office suite, incl. MS Office/Office 365, Teams, Skype),
For autonomous work	Auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the EIOS	Computer class; technical equipment: personal computers, projection screen, multimedia projector, NEC NP-V302XG, Internet access. Software: Microsoft products (OS, office suite, including. MS

		Office/Office 365, Teams, Skype)
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7. RESOURCES RECOMMENDED FOR THE COURSE:

Main literature:

1. Веллер В.Н. Автоматическое ренулирование паровых турбин М., "энергия", 1977
2. Цанев, В.Д. Буров, А.Н. Ремезов. Газотурбинные и парогазовые установки тепловых электростанций. [Электронный ресурс]
https://www.studmed.ru/canev-sv-i-dr-gazoturbinnye-i-parogazovye-ustanovki-teplovyyh-elektrostantsiy_22c135f50bf.html

Additional readings:

Electronic library systems:

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:
 - RUDN Electronic Library System (RUDN ELS) <http://lib.rudn.ru/MegaPro/Web>
 - EL "University Library Online" <http://www.biblioclub.ru>
 - EL "Yurayt" <http://www.biblio-online.ru>
 - EL "Student Consultant" www.studentlibrary.ru
 - EL "Lan" <http://e.lanbook.com/>
 - EL "Trinity Bridge"
2. Databases and search engines:
 - electronic foundation of legal and normative-technical documentation <http://docs.cntd.ru/>
 - Yandex search engine <https://www.yandex.ru/>
 - Google search engine <https://www.google.ru/>
 - Scopus abstract database <http://www.elsevierscience.ru/products/scopus/>

The training toolkit and guidelines for a student:

1. Collection of lectures on the course Automatic heat engine control.

* The training toolkit and guidelines for the course are placed on the internship page in the university telecommunication training and information system under the set procedure.

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS INTERNSHIP RESULTS

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as the course Automatic heat engine control results are specified in the Appendix to the internship syllabus.

* The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

DEVELOPERS:

Associate Professor in the Department
of Energy Engineering

position, educational department

Oshchepkov P.P.

name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

Head of the Department of
Energy Engineering

position, educational department

Yu.A. Radin

signature

name and surname

**HEAD OF
HIGHER EDUCATION PROGRAMME:**

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