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

Mathematical modeling of thermal processes

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

2024г.

1. The COURSE GOAL

The discipline "Mathematical modeling of thermal processes" is included in the master's degree program "Mechanical Engineering" in the direction of 13.04.03 "Energy Engineering" and is studied in the 1st semester of the 1st year. The discipline is implemented by the Basic Department of Energy Engineering. The discipline consists of 6 sections and 6 topics and is aimed at studying methods of mathematical modeling of thermal processes of heat engines.

The purpose of mastering the discipline is to form knowledge in the mathematical modeling of thermal processes of installations with steam and gas turbines. The task of the discipline is the formation of practical skills in the mathematical modeling of thermal processes of installations with PGT.

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-2	Ability to apply modern research methods, evaluate and present the results of the work performed.	GPC-2.1. Selects the necessary research method to solve the task; GPC-2.2. Analyzes the results obtained; GPC-2.3. Represents the results of the work performed.

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 ofthe 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.		Special chapters of the theory of heat engines Automatic heat engine control Alternative Energy Sources Practice in obtaining primary skills of research work.
GPC-2	Ability determine and implement the priorities of his own activities and ways to improve them based on self-assessment	-	Modern issues of power engineering science and manufacture.

* - 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 *4 credits, 144 hours.Table 4.1.* Form of study work of EP HE

Type of academic activities		Total academic hours	Semester(s)			
			1			
Contact academic hours		36	36			
including:						
Lectures (LC)		18	18			
Lab works (LW)		0	0			
Seminars (workshops / tutorials) (S)		18	18			
Self-studies academic hours		72	72			
Evaluation and assessment academic hours		0	0			
Course work / project, credits		0	0			
Course workload	academic hours	108	108			
	credits	3	3			

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 Modeling the properties of working bodies in thermal processes.	Problems arising in the mathematical modeling of processes in thermal power engineering and related to the calculation of the properties of working bodies.	LC, SM, AW
Section 2 Fundamentals of mathematical modeling of thermal processes.	Classification of the main problems arising in the modeling of processes in thermal power engineering (problems of strength, hydrodynamics, conjugate heat transfer), The main stages of solving each of them, an example of widespread application software packages for solving them.	LC, SM, AW
Section 3 Mathematical models of hydro- and gas dynamics.	Общее представление об основных задачах расчёта течений регулирующих и не регулирующих сред применительно к моделированию процессов в теплоэнергетике. Основные и наиболее широко используемые математические модели ламинарных и турбулентных течений.	LC, SM, AW
Section 4 Mathematical models of multiphase flows and gorenje.	Описание наиболее широко используемых моделей течений многофазных сред, в том числе с процессами горения.	LC, SM, AW
Section 5 Mathematical models of heat transfer.	Основные модели теплопереноса для решения задач сопряжённого теплообмена, постановка граничных условий при решении задач сопряжённого теплообмена.	LC, SM, AW
Section 6 Mathematical models for calculating the state of stress-deformed	Basic mathematical models for calculating the state of stress-strain bodies, models of media and methods for solving equations based on these models.	LC, SM, AW

bodies.		

* - 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 pro-jector, NEC NP-V302XG, Internet access. Software: Microsoft products (OS, office suite, including. MS Office/Office 365, Teams, Skype)

7.RESOURCES RECOMMENDED FOR THE COURSE:

Main literature:

1. Аверченков В. И., Федоров В. П., Хейфец М. Л. Основы математического моделирования технических систем. Брянск: Брянский государственный технический университет 2012

2. В.М. Пестриков Математическое моделирование теплотехнических задач в программируемых средах [Текст]: учебное пособие М-во образования и науки РФ, СПбГТУРП. – СПб.: СПбГТУРП 2009

Additional readings:

1. Бараков А.В. Моделирование и алгоритмизация задач теплоэнергетики: учебное пособие / А.В. Бараков, А.А. Надеев, В.И. Ряжских. – Воронеж: ФГБОУ ВО «Воронежский государственный технический университет», 2015. – 198 с.

2. Голдаев С.В. Практикум по математическому моделированию в теплоэнергетике: учебное пособие / С.В. Голдаев. – Томск: Изд-во Томского политехнического университета, 2011. – 152 с.

3. Бондарь А.Г. Математическое моделирование в химической технологии / А.Г. Бондарь. – Киев: «Вища школа», 1973. – 280 с.

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 Mathematical modeling of thermal processes.

* 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 Mathematical modeling of thermal processes 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:

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position, educational department	signature	name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

Head of the Department of Energy Engineering		Yu.A. Radin
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HEAD OF HIGHER EDUCATION PROGRAMME:

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