Federal State Autonomous Educational Institution of Higher Education
Patrice Lumumba Peoples ' Friendship University of Russia

Engineering Department the academy
(full name the main one training center divisions (PMO)-developer OP HE)

WORKING PROGRAM OF THE DISCIPLINE

HEAT EXCHANGE EQUIPMENT
(name of the discipline / module)

Recommended by the MSS for the direction of training/specialty:

13.04.03 POWER ENGINEERING
(code and name of the training area/specialty)

Getting started disciplines ongoing in within the framework of implementations main professional educational program programs higher education level educational institutions (OP HE):

OPERATION OF POWER SYSTEM EQUIPMENT
(name (profile/specialization) of the OP HE)

2025

1. THE PURPOSE OF MASTERING THE DISCIPLINE

The discipline "Heat Exchange Equipment" is included in the Master's program "Operation of power systems equipment" in the direction 13.04.03 "Power Engineering" and is studied in the 3rd semester of the 2nd year. The discipline is implemented by the Basic Department "Power Engineering". The discipline consists of 7 sections and 7 topics and is aimed at studying the device, operating principles, basic parameters and characteristics of heat exchangers.

The purpose of mastering the discipline is to form knowledge about the device, operating principles, basic parameters and characteristics of heat exchangers. Objectives of the discipline: to consider the designs of regenerative and regenerative heat exchangers; to study the characteristics and trends in the development of heat exchanger designs; to master the methods of thermal, structural and hydraulic calculations of heat exchange equipment.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the "Heat Exchange Equipment" discipline it is directed to the formation of y students of the following competencies (parts of competencies):

Table 2.1. List competencies, generated data at students by mastering it disciplines (results of development disciplines)

Code	Competence	**Indicators achievements competencies** (in within the framework of this one disciplines)
UK-7	Able to search for the right ones sources for more information and data, perceive, analyse, memorize and transmit information from using digital resources facilities, but also with using algorithms when working with obtained from various sources sources with data with goal effective use received information for problem solving; conduct research on the following issues: rating for more information, her reliability, build logical ones inferences on based on incoming users for more information and data source	UK-7.1 Know the methods of collecting and processing information from the Internet. using digital tools, as well as current issues Russian companies and foreign companies sources for more information in area of interest professional activities, principles, methods and tools decisions standard ones tasks professional activities with using digital facilities and based on the main ones requirements information system safety; UK-7.2 Be able to to apply methods search results, collecting data and processing options for more information; with using digital resources facilities, perform critical analysis and synthesis of information, received from different sources, and solve standardtasks. tasks professional activities with using digital funds and with taking into account the main requirements information system safety; UK-7.3 Own by methods search results, collecting data and processing options, critical analysis and yandex. Metrica for more information with using digital tools for solving tasks, skills preparation of reviews, annotations, and abstracts, scientific reports, publications and bibliographies by scientific-research team working hours with using digital facilities and with taking into account the requirements information system safety;

PC-4	Capable of use knowledge theoretical foundations of workers processes in the energy sector cars, mobile devices and installations, methods current account number analysis objects professional activities	PC-4.1 Implementation scientific guidelines by conducting research on separate tasks; PC-4.2 Management results scientific research projects and development projects works'; PC-4.3 is capable of using modern information technologies. technologies by carrying out scientific research projects works';

3. THE PLACE OF THE DISCIPLINE IN THE STRUCTURE OF THE OP HE

The "Heat Exchange Equipment" discipline belongs to the part formed by the participants of educational relations in block 1 "Disciplines (modules)" educational programs of higher education.

Within the framework of the higher education program, students also master other disciplines and/or practices that contribute to achieving the planned results of mastering the "Heat Exchange Equipment" discipline.

Table 3.1. List components OP MD, contributing factors achievement planned ones results development plans disciplines

Code	**Name competencies**	**Previous events disciplines/modules, practices***	**Follow-ups disciplines/modules, practices***
UK-7	Able to search for the right ones sources for more information and data, perceive, analyse, memorize and transmit information with using digital facilities, but also using algorithms when working with the received data from various sources with data with the goal effective use cases received information for the solution tasks; perform an assessment for more information, her confidence level, build logical ones inferences on based on incoming users for more information and data source	Modern information systems technologies; Geographic information systems the system and their application; Digital technologies in energy sector mechanical engineering;	Scientific and research Organization practice;
PC-4	Capable of use knowledge theoretical issues the basics workers processes in p ower machines, devices and installations, methods current account number object analysis professional activitie s	Scientific and research Organization work; Modern information systems technologies; Methods tests turbomachines; Digital technologies in energy sector mechanical engineering;	Pre-graduate practice; Scientific and research Organization practice;

* - filled in in accordance with the matrix of competencies and skills of the OP HE

** - elective disciplines /practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF ACADEMIC WORK

The total labor intensity of the "Heat Exchange Equipment "discipline is "2" credits.

Table 4.1. Kinds educational program works by periods development plans educational program programs higher education level educational institutions for full-time forms training.

View educational program works	**in total, ac. h.**		**Semester (s)**
			3
Contact work, ac. h.	*36*		*36*
Lectures (**LC**)	18		18
Laboratory work (**LR**)	0		0
Practical/ seminar classes (**SC**)	18		18
Independent work of students, ac. h.	*27*		*27*
Control (exam / test with assessment), ac. h.	*9*		*9*
General labor intensity disciplines	**ac. h.**	***72***	*72*
	monthly units	***2***	*2*

5. CONTENT OF THE DISCIPLINE

Table 5.1. Content disciplines (of the module) by by types educational program works

Number of the section	**Name of the section disciplines**	**Content of the section (topics)**		**View educational program works ***
Chapter 1	Common intelligence about heat exchangers mobile devices	1.1	Appointment heat exchangers mobile devices. Kinds heat exchangers mobile devices. Heat exchangers mobile devices energy companies installations. Role heat exchangers mobile devices in thermodynamic parameters cycles. Heat exchangers directly participating companies in organizations thermodynamic cycles. Heat exchangers mobile devices, providing services work auxiliary equipment. Mechanisms transfers heat. Physical properties processes, leaking data in heat exchangers mobile devices	LC, SC
Chapter 2	Structures heat exchangers mobile devices, used by in energy sector mechanical engineering	2.1	Kinds of heat carriers in heat exchangers mobile devices, used by in energy sector mechanical engineering. Security methods transfer of heat carriers, advantages and disadvantages disadvantages used by technical issues solutions. Tubular heat exchangers. Lamellar heat exchangers. Regenerative systems and regenerative systems heat exchangers. Intermediate heat carrier. Thermal solutions tubes.	LC, SC
Chapter 3	The basics theories heat exchange rate	3.1	Ratio thermal conductivity. Ratio heat transfer. Ratio heat transfer. Thermal resistance. Temperature Range pressure. Logarithmic mean temperature range pressure. The number of heat transfer units NTU. Criteria similarities. Equivalent diameter. Thermal flow, density heat pump stream size	LC, SC
Chapter 4	Raising intensities heat exchange rate	4.1	Specific weight thermal flow. Ratio heat transfer. Difference temperatures. Logarithmic mean meaning differences temperatures. Factors affecting on ratio heat transfer. Factors, influencers on logarithmic mean meaning temperature differences. Selecting a heat exchange system surfaces. Artificial turbulization behind score magnifications relative value roughness surfaces. Application ultrasound.	LC, SC

Chapter 5	Calculation basics regenerative systems heat exchangers mobile devices	5.1	Main types of problems solved during calculations heat exchangers mobile devices. Engineering services methods calculation results heat exchangers. Design documents calculations (reverse task). Source data data for the design calculation. Technical specifications requirements to to the project manager to the heat recovery unit. Choice concepts heat recovery unit. Choice heat exchange unit surfaces and specific features sizes. Speed selection movements heat carriers. Calculation the coefficient heat transfer. Calculation square footage heat exchange unit surfaces (two of the method): 1.1. Calculation square footage heat exchange surface with using the temperature head; 1.2. Calculation of the heat exchange surface area with using NTU. Calculation hydraulic systems resistances. Calculations with goal definitions featu res heat exchangers (direct line task). Source data data for definitions characteristics of heat exchangers. Calculation performance indicators heat exchange equipment the device. Calculation hydraulic systems resistances.	LC, SC
Chapter 6	Features calculation results regenerative systems heat exchangers mobile devices	6.1	Accounting non-stationarities heat exchange. Accounting transfer information heat carriers. Accounting spillovers heat carriers. Choice equivalent to the diameter.	LC, SC
Chapter 7	Heat exchangers mobile devices PSU	7.1	Vaporizers. Condensers.	LC, SC

* - filled in only by **FULL-TIME** form of training: *LC-lectures; LR – laboratory work; SC – seminar classes.*

6. MATERIAL AND TECHNICAL SUPPORT OF THE DISCIPLINE

Table 6.1. Material and technical support provision disciplines

Type audiences	**Equipment audiences**	**Specialized training/la boratory hardware, software, and materials to master disciplines (if necessary)**
Lecture Hall	Classroom for conducting classes lecture type, equipped with a set of specialized furniture; using a blackboard (by screen) and by technical means by other means multimedia presentations.	The projector, a laptop

Seminar room	Classroom for conducting classes seminary level like, group services and individual services consultations, current one monitoring and interim certification, equipped with a set specialized furniture and accessories by technical means by other means multimedia presentations.	Blackboard magnetic marker system
For independent works	Classroom for independent work students (can be used for conducting seminars and seminars consultations), equipped with a set of specialized furniture and by computers with access point in EIOS.	

* - auditorium for independent works students specified by **necessarily**!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. Бухмиров В.В., Ракутина Д.В., Солнышкова Ю.С., Пророкова М.В. Тепловой расчет рекуперативного теплообменного аппарата / ФГБОУ ВПО «Ивановский государственный энергетический университет имени В.И. Ленина». – Иваново, 2013. – 124 с.
2. Таранова Л.В. Теплообменные аппараты и методы их расчета : учебное пособие / Л. В. Таранова. – 2-е изд., перераб. и доп. – Тюмень : ТюмГНГУ, 2012. – 198 с.

Additional information literature:

1. Цветков, Ф. Ф. Тепломассообмен: учебник для вузов / Ф. Ф. Цветков, Б.А. Григорьев - Москва : Издательский дом МЭИ, 2021. - 562 с. - ISBN 978-5-383-01172-0.
2. Ягов, В.В. Теплообмен в однофазных средах и при фазовых превращениях: учебное пособие для вузов / В.В. Ягов - Москва : Издательский дом МЭИ, 2021. - 542 с. - ISBN 978-5-383-01172-0.

Resources information and telecommunication system networks "Internet ":

1. ЭБС РУДН and third-party servicesЭБС, to which one students of the university they have access on based on prisoners agreements
   - Электронно-библиотечная система РУДН – ЭБС РУДН http://lib.rudn.ru/MegaPro/Web
   - ЭБС «Университетская библиотека онлайн» http://www.biblioclub.ru
   - ЭБС Юрайт http://www.biblio-online.ru
   - ЭБС «Консультант студента» www.studentlibrary.ru
   - ЭБС «Троицкий мост»
2. Базы данных и поисковые системы
   - электронный фонд правовой и нормативно-технической документации http://docs.cntd.ru/
   - поисковая система Яндекс https://www.yandex.ru/
   - поисковая система Google https://www.google.ru/
   - реферативная база данных SCOPUS http://www.elsevierscience.ru/products/scopus/

Educational and methodical materials materials for independent works students by mastering it discipline/module:*

1. Course lectures by by discipline «Heat Exchange Equipment».

* - all teaching materials for independent work of students are placed in accordance with the current procedure on the discipline page **in TUIS**!

8. EVALUATION MATERIALS AND A POINT-RATING SYSTEM FOR ASSESSING THE LEVEL OF COMPETENCE FORMATION IN THE DISCIPLINE

Assessment materials and a point-rating system* assessment of the level of competence formation(parts of competencies) based on the results of mastering the discipline "Heat Exchange Equipment" is presented in the Appendix to this Work Program of the discipline.

* - OM and BRS are formed on the basis of the requirements of the relevant local regulatory act of the RUDN University.

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