MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
«KHARKIV POLYTECHNIC INSTITUTE»

APPROVED BY
Rector of NTU "KhPI"
_____Ye.I.Sokol
«____»_____2019.

EDUCATIONAL AND PROFESSIONAL PROGRAM

«INDUSTRIAL AND MUNICIPAL HEAT-AND-POWER ENGINEERING. ENERGY MANAGEMENT AND ENERGY EFFICIENCY»

The Second (Master) Level

by specialty 144 «Heat-and-Power Engineering»

Area of knowledge 14 «Electrical Engineering»

Qualification: Master of Heat and Power Engineering

CONFIRMED BY
THE SCIENTIFIC COUNCIL
The Scientific Council Head
_____/L.L. Tovazhnyanskyy /
(protocol № ___of « _ » ___ 2019.)
Educational program installed from
_____2019
Rector
_____ / Ye.I.Sokol /
(order No. ___ of "___"_____ 2019.)

Kharkiv 2019

COORDINATION PAGE
of educational and professional program

Higher education level	The Second (Master) Level
Area of knowledge	14 Electrical Engineering
Specialty	144 Heat-and-Power Engineering
Specializations	144-01 Industrial and Municipal Heat-And-Power Engineering
	144-02 Energy Management and Energy Efficiency
Qualification	Master of Power Engineering

CONFIRMED
by Scientific and Methodical Committee
for the specialty
Committee Head

_____A.M. Ganzha

«____»_____2019.

RECOMMENDED
by Methodical Council of NTU "KhPI"
Deputy Head of Methodical Council

_____R.P. Mygushchenko

«____»_____2019.

COORDINATED
Head of the Department
of Heat-and-Power Engineering

_____ A.M. Ganzha

«____»_____2019

COORDINATED
Head of the Institute of Power
Engineering, Electronics and
Electromechanics

_____ R.S. Tomashevskyi

«____»_____2019

APPROVED AND PROVIDED

By order No. _____.of the rector of the National Technical University "Kharkiv Polytechnic Institute" from «_____» _____2019

INTRODUCTION

Developed by the working group of the Department of Heat-and-Power Engineering

Working group members:

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Anton Mikolaevich Ganzha, D.Sc., professor, Head of the Department of Heat-and-Power Engineering _____

Educational program viewed and confirmed by
Methodical Council of NTU "KhPI"
of «____» _____ 2019
protocol No. _____

Deputy Head of Methodical Council
R.P. Mygushchenko

Scientific Secretary of Methodical Council

1. ПРОФІЛЬ ОСВІТНЬО-ПРОФЕСІЙНОЇСПЕЦІАЛІЗОВАНОЇ ПРОГРАМИ ЗА СПЕЦІАЛЬНІСТЮ 144 «ТЕПЛОЕНЕРГЕТИКА»

1 – Загальна інформація	
Full name of higher educational institution and structural unit	National Technical University "Kharkiv Polytechnic Institute" Institute of Education and Science in Power Engineering, Electronics and Electromechanics Department of Heat-and-Power Engineering
The degree of Higher education and the name of the qualification in the original language title	Ступінь вищої освіти - Магістр з теплоенергетики Освітня кваліфікація – Магістр з теплоенергетики Кваліфікація в дипломі - Професіонал з теплоенергетики
The official name of the educational program	Educational and professional program «Industrial and Municipal Heat-And-Power Engineering. Energy Management and Energy Efficiency» of The Second (Master) Level of higher education
Type of diploma and extent of educational program	Master's degree, individual, 90 ECTS credits,1 year and 4 months of training
Availability of accreditation	Protocol No. 116, order No. 1415*l* of 10.06.2015.
Cycle / program level	FQ-EHEA – second cycle, QF LLL – 7 level, NQF Ukraine – 8 level
Prerequisites	Availability of a bachelor's degree
Language (s) of teaching	Ukrainian, Russian, English
Period of validity of the educational program	According to the period of validity of accreditation certificate
Web address of the continual access on the educational program description	http://web.kpi.kharkov.ua/teplo/dokumentatsiya-z-navchalnogo-protsesu/
2 – The purpose of the educational program	
The purpose of the educational program for student is to combine a high level of professional training with the formation of a scientific outlook and a broad scope in the social, economic and professional fields. The purpose of training is to train specialists who can independently carry out design, analysis of efficiency and reliability, optimization of heat and power devices and systems; apply modern energy-efficient technologies; to increase environmental safety.	
3 – Characteristics of the educational program	
Subject area (area of knowledge, specialty, specialization)	Knowledge field title: «Electrical engineering» Specialty title: «Heat-And-Power Engineering » Specializations: Block 1. Industrial and Municipal Heat-And-Power Engineering. Block 2. Energy Management and Energy Efficiency
Orientation of the educational program	The purpose of training is to train specialists who can independently carry out design, analysis of efficiency and reliability, optimization of heat and power devices and systems; apply modern energy-efficient technologies; to increase environmental safety.
The main focus of the educational program and specialization	Special education in the field of electrical engineering in the specialty "Heat-And-Power Engineering" with specializations in industrial and municipal heat and power engineering, energy management and energy efficiency. Key words: production of heat, electricity and cold, fuel and energy sources, heat and mass transfer, heat engineering plants, air

	conditioning, heat supply, heating, energy efficiency, energy saving, energy management, energy audit.
Features of the program	The educational and professional master's degree program is developed for students who seek to become specialists in engineering and research in the field of heat and power engineering. The main advantage of the master's program is to focus on the formation of the broadest scientific and technical outlook of the future professional. The program is balanced in terms of social and humanitarian, and professional training and contains sufficient component extracts in the specialization. This gives the opportunity to get basic knowledge of fundamental and natural sciences, disciplines of general and special training.
4 – Aptitude graduates for employment and further education	
Aptitude for employment	Professional qualification corresponds to the issue of "Classifier of Occupations" – the technical specialists in the field of physical sciences and engineering; specifically a qualification to a bachelor of heat and power engineering is given. Professional capabilities of graduates (according to the "Classifier of professions" DK 003: 2010) are as following. The graduate can hold engineering and management positions: power engineering specialist, production power engineer, district power engineer, workshop power engineer, operator of diesel and refrigeration units, heat engineer, state inspector for energy supervision over the rates of consumption of electric and heat energy, engineer of relevant units of heat and power companies, engineer-designer , specialist in energy departments of public authorities, energy audit.
Further education	Further education at the third (educational-scientific) level of higher education is available.
5 – Teaching and Assessment	
Teaching and learning	Lectures, laboratory and practical classes, scientific and practical seminars, implementation of training and real projects (project training), problem-oriented learning and in-service training, student-centered training, dual training, distance and mixed learning, self-study, practice, preparation of graduating work.
Assessment	Current and final control of knowledge (oral tests, control and individual tasks, testing, etc.), credits and exams (oral and written), defence of educational projects with the presentation, public defence of qualification work. Rating system of assessment, oral and written examinations, testing. The assessment system involves the use of an international system of ECTS (with grades A, B, C, D, E, F), the national system (rated "excellent", "good", "satisfactory" and "unsatisfactory"), as well as 100-point HEI systems with established responsibility system.
6 – Program competencies	
Integral competence	Ability to solve complex specialized, scientific and practical problems of heat and power engineering in the professional activity or in the process of training, which involves using of mathematical theories, methods, algorithms, information technologies and specialized software. It is characterized by complexity and uncertainty of the conditions.

General competencies (GC)	**GC-1**. Knowledge and understanding of the subject area and understanding of the profession. **GC-2**. Ability to think, analyze and synthesize. **GC-3**. Ability to identify, put and solve problems. **GC-4.** Ability to perform research and analyze the results at the appropriate level. **GC-5.** Ability to develop and manage projects. **GC-6**. Ability to estimate and ensure the quality of work performed. **GC-7.** Ability to communicate with non-professionals in their field (with experts from other fields). **GC-8.** Determination and persistence on the tasks and duties taken. **GC-9.** The desire to save the environment. **GC-10.** Ability to act in a socially responsible and civic conscious manner.
Professional competence (PC) (Determined by the standard of higher specialty education)	**PC-1.** Ability to develop, apply and improve mathematical models, scientific and technical methods and modern computer software for solving engineering problems in the heat engineering industry. **PC-2.** Ability to apply, integrate and analyze knowledge and understanding from other engineering disciplines. **PC-3.** Ability to apply a systematic approach, knowledge of modern technologies and methods in the design and operation of heat and power equipment. **PC-4.** Ability to demonstrate knowledge and understanding of the formation and application of mathematical principles and methods required in the heat engineering industry. **PC-5.** Ability to propose and substantiate measures to improve the efficiency of heat and power facilities and systems, taking into account limitations, including those related to environmental protection, stable development, health and safety, and to estimate risk in the heat engineering sector. **PC-6.** Ability to analyze and develop measures to improve the efficiency of systems and components based on the use of analytical methods and simulation methods in the heat engineering industry. **PC-7.** Ability to apply knowledge and understanding of the commercial and economic context in the heat engineering industry. **PC-8.** Ability to apply understanding of the broader interdisciplinary engineering context and its main principles. **PC-9.** Ability to apply understanding of the issues of the use of technical literature and other sources of information in the heat engineering industry. **PC-10.** Ability to design, implement and accompany projects taking into account all aspects of the problem being solved, including the design, manufacture, operation, maintenance and utilization of heat and power equipment. **PC-11.** Ability to keep to the professional and ethical standards of a high level in the activity of the heat and power industry. **PC-12.** Ability to keep to the aspects of quality in the heat engineering industry. **PC-13.** Ability to apply knowledge of the characteristics and properties of materials, equipment, processes in the heat engineering industry. **PC-14**. Ability to apply knowledge of intellectual property and

	contracts in the heat engineering industry. **PC-15.** Ability to apply a scientific approach in designing, analyzing and modernizing heat and power facilities and systems.
Professional competencies of specialization (Determined by the institution of higher education) (PCS)	**PCS1-1.** Ability and readiness to apply modern methods of research, perform technical tests and scientific experiments, evaluate the results of the work performed. **PCS1-2.** Ability to professionally use of modern equipment and devices. **PCS1-3.** Ability to use modern and advanced computer and information technologies. **PCS1-4.** Ability to formulate tasks for the development of design decisions related to the modernization of technological equipment, measures to improve performance, increase environmental safety, improve working conditions, and save resources. **PCS1-5.** Ability to determine the indicators of the technical level of projected objects or technological schemes. **PCS1-6.** Ability to use application software for calculation and choosing of parameters of heat and power engineering, heat engineering and heat technology equipment. **PCS1-7**. Ability to apply methods and means of automated control systems of technological processes in heat power engineering, heat engineering and heat engineering. **PCS2-1**. Ability to determine the need for production in fuel and energy resources, to prepare reasoning for technical re-equipment, development of the heat and power industry, reconstruction and modernization of enterprises - sources of energy and power supply systems. **PCS2-2.** Ability to justify measures for energy resources saving, develop norms of their expenses, calculation of needs for production in energy resources. **PCS2-3.** Ability to perform technical and economic calculations on projects, and cost-effectiveness analysis of the effectiveness of design decisions. **PCS2-4.** Ability to perform calculations with necessary reasoning of measures to save energy resources and the needs of enterprises in the electric, heat and other types of energy, participate in the development of norms of their costs, the mode of operation of units of the enterprise, based on their energy needs. **PCS2-5.** Ability to use quantitative and qualitative methods for carrying out scientific researches and management of business processes. **PCS2-6**. Ability to prepare analytical materials for managing business processes and estimate their effectiveness. **PCS2-7.** Ability to carry out energy audits of objects and estimate the effectiveness of projects and energy saving measures. **PCS2-8.** Ability to substantiate and implement the energy management system and the involvement of energy service companies in industrial enterprises and municipal services.
7 – Programmed results of training	

Programmed results of training in the specialty (defined by the standard of higher education by specialty) (PRT)	**PRT-1**. Knowledge and understanding of mathematics, physics, chemistry, hydrodynamics, heat and mass transfer, technical thermodynamics, strength, transformation of energy, technical mechanics, heat engineering processes and equipment, economics at the level necessary to achieve other results of the educational program. **PRT-2.** Knowledge and understanding of special engineering, economical and environmental aspects, at the level necessary for the achievement of the results of the educational program, including taking into account the latest achievements of science and technology. **PRT-3.** Knowledge and understanding of the specific aspects of the relevant specialization at the level necessary to achieve other results of the educational program. **PRT-4.** Ability to analyze, apply and create complex engineering technologies, processes, systems and equipment in accordance with the specialty "Heat and Power Engineering"; choose, analyze and develop suitable standard analytical, computational and experimental methods; analyze the results of such studies. **PRT-5.** Ability to set and / or solve engineering and scientific tasks according to the specialty "Heat and Power Engineering"; taking into account the importance of non-technical (social, health, safety, and environment-bounded, economic and industrial) restrictions. **PRT-6.** Ability to develop, design, upgrade and analyze complex products in the heat energy industry, processes and systems that meet established requirements, which may include awareness of non-technical (social, health, safety, and environment-bounded, economic and industrial) aspects; to analyze the adequacy of the design methodology. **PRT-7.** Ability to use advanced achievements when designing objects in the heat engineering industry. **PRT-8.** Understanding the main aspects of implementation and support of projects, innovation and intellectual property protection. **PRT-9.** Ability to analyze the necessary information from technical literature, databases and other relevant information sources, on this basis, to carry out simulations for the purpose of detailed study and research of the thermophysical and other processes that are the subject of the educational program. **PRT-10.** Ability to apply methods of planning experimental research, to carry out them with the help of instrumental means (measuring instruments) and to process results with the help of computer technology, to assess the adequacy of research results. **PRT-11.** Systematic understanding of key aspects and concepts in the heat engineering industry, technology of production, transmission, distribution and use of energy. **PRT-12.** Understanding and experience in applying design and research techniques, as well as their limitations in accordance with other requirements of the educational program. **PRT-13.** Practical skills in substantiating and implementing engineering projects, conducting surveys and research in accordance with the specialization of the requirements of the educational program.

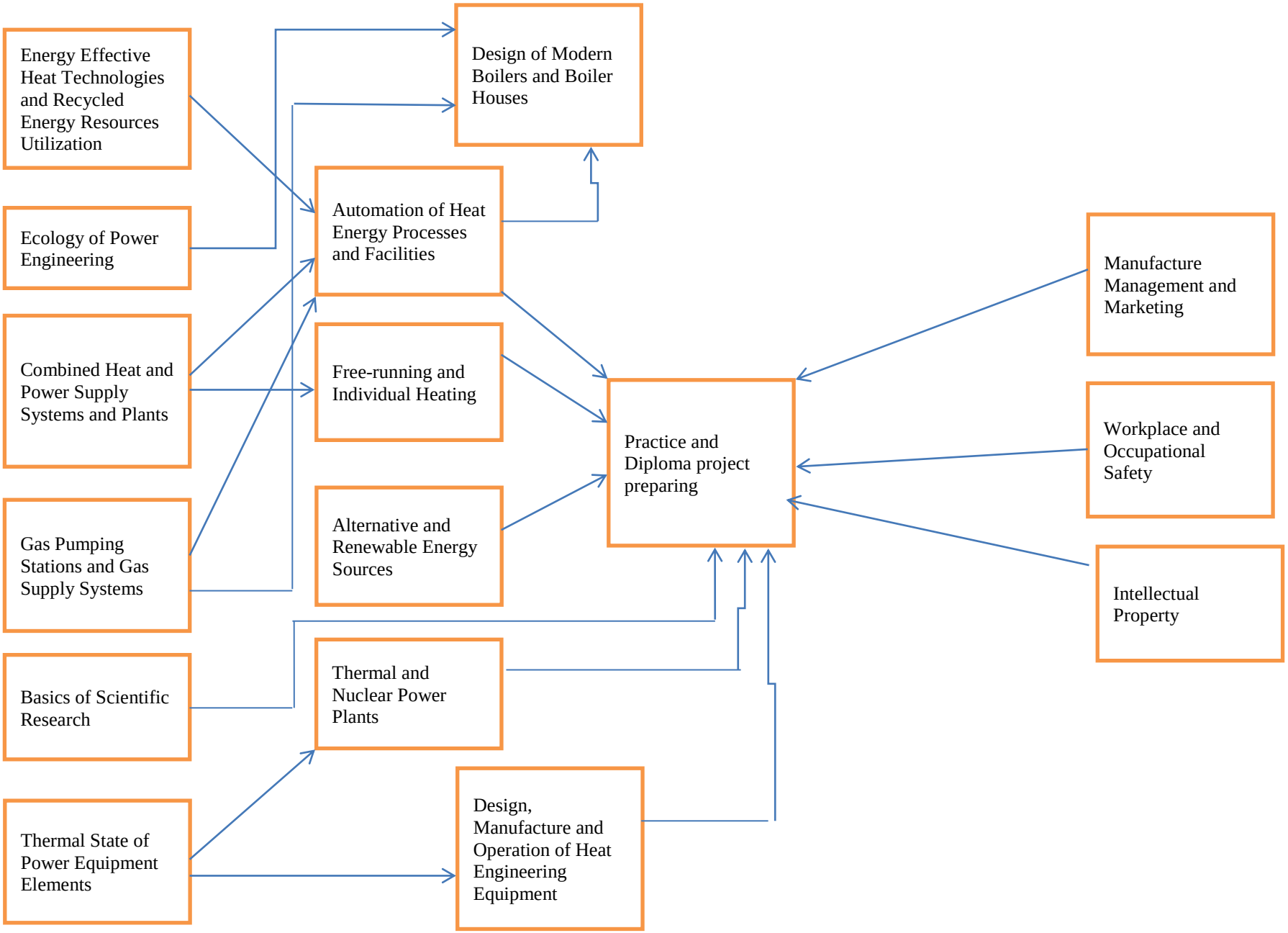
	PRT-14. Understanding and practical skills in choosing and justifying the use of materials, equipment and tools, engineering technologies and processes, as well as restrictions on them in the heat and power engineering industry. **PRT-15.** Practical skills in application of the norms of engineering practice in heat power engineering. **PRT-16**. Practical skills in non-technical (social, health, safety, and environment-bounded, economic and industrial) consequences of engineering practice. **PRT-17.** Ability to report opinion on heat energy issues, taking into account relevant technical, environmental, economic, social and ethical issues. **PRT-18.** Ability to manage and be responsible for the design, implementation and maintenance of projects (or of their parts) in heat and power engineering, assuming responsibility for decision-making. **PRT-19.** Ability to effectively communicate on issues of business relations, information, ideas, problems and decisions with the management, engineering community and society as a whole. **PRT-20**. Ability to work effectively in the national and international context, both as a person and as a member of a team, and to effectively co-operate with executives, engineers, employees, professionals and the public. **PRT-21.** Ability to independently study for a lifetime, taking into account the previous experience. **PRT-22.** Ability to track the development of science and technology and apply modern knowledge.
rogrammed results of training in a specialty (defined by the institution of higher education) (PRTS)	**PRTS 1.** Understanding the design and research methods being applied, as well as their limitations in accordance with the specializations "Industrial and Municipal Heat-and-Power Engineering" and "Energy Management and Energy Efficiency". **PRTS 2.** Knowledge and understanding of engineering issues underlying specializations "Industrial and Municipal Heat-and-Power Engineering" and "Energy Management and Energy Efficiency" at the level necessary for achieving other results of the educational program, including certain knowledge in the latest achievements of science and technology. **PRTS 3.** Practical skills in solving problems that involve the implementation of engineering projects and research performing in accordance with the specializations "Industrial and Municipal Heat-and-Power Engineering" and "Energy Management and Energy Efficiency". **PRTS 4**. Ability to manage professional activity, take part in work over projects in accordance with the specializations "Industrial and Municipal Heat-and-Power Engineering" and "Energy Management and Energy Efficiency", assuming responsibility for decision having been made. **PRTS 5.** Ability to apply the standards of engineering practice in accordance with the "Industrial and Municipal Heat-and-Power Engineering" and "Energy Management and Energy Efficiency".
8 – Resource support for the implementation of the program	
Peopleware	It meets the personnel requirements for ensuring the implementation of educational activities in the field of higher

	education in accordance with the current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine "On Approval of Licensing Conditions for the Educational Activities of Educational institutions" of December 30, 2015, No. 1187, Appendix 12).
Material and technical provision	It meets the requirements for the material and technical provision of educational activities in the field of higher education in accordance with the current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine "On Approval of Licensing Conditions for the Educational Activities of Educational Institutions" dated December 30, 2015, No. 1187, Appendix 13).
Information and educational provision	It meets the requirements for the information and educational provision of educational activities in the field of higher education in accordance with the current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine "On Approval of Licensing Conditions for the Educational Activities of Educational Institutions" dated December 30, 2015, No. 1187, Appendix 14).
9 – Academic mobility	
National Credit Mobility	On the basis of bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and the leading technical universities of Ukraine.
International Credit Mobility	On the basis of bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and higher education institutions of foreign partner countries.
Training foreign applicants for higher education	Possible after studying the Ukrainian language course.

2. LIST OF EDUCATIONAL PROGRAM COMPONENTS

Code	Educational program components (disciplines, projects / work, practice, qualification work)	Credits ECTS	Form of final control
MANDATORY COMPONENTS OF THE EDUCATIONAL PROGRAM			
1. General training cycle			
DP 1.1	Workplace and Occupational Safety	3	Test
DP 1.2	Intellectual Property	3	Test
DP 1.3	Manufacture Management and Marketing r	3	Test
2. Professional and practical training cycle			
2.1. Professional training in specialty			
PT 2.1.1	Energy Effective Heat Technologies and Recycled Energy Resources Utilization	4	Exam
PT2.1.2	Ecology of Power Engineering	4	Test
PT2.1.3	Combined Heat and Power Supply Systems and Plants	5	Exam
PT2.1.4	Gas Pumping Stations and Gas Supply Systems	4	Exam
PT2.1.5	Basics of Scientific Research	3	Test
PT2.1.6	Thermal State of Power Equipment Elements	4	Exam
2.2. Practical training in specialty			
PT 2.2.1	Practice	15	Test
PT 2.2.2	Diploma project preparing (DP)	15	Defense of DP
Total volume of mandatory components		**63**	
OPTIONAL COMPONENTS OF THE EDUCATIONAL PROGRAM (BY BLOCKS)			
3. Blocks for professional training choosing			
Discipline block 3.1. «Industrial and municipal heat-and-power engineering»			
OB 3.1.1	Design of Modern Boilers and Boiler Houses	5	Exam
OB 3.1.2	Automation of Heat Energy Processes and Facilities	4	Exam
OB 3.1.3	Free-running and Individual Heating	3	Test
OB 3.1.4	Alternative and Renewable Energy Sources	5	Exam
OB 3.1.5	Thermal and Nuclear Power Plants	5	Exam
OB 3.1.6	Design, Manufacture and Operation of Heat Engineering Equipment	5	Exam
Discipline block 3.2. «Energy management and energy efficiency»			
OB 3.2.1	Energy Management and Audit	5	Exam
OB 3.2.2	Energotechnological Complexes of Industrial Enterprises	4	Exam
OB 3.2.3	Energy Accounting Systems	3	Test
OB 3.2.4	Alternative and Renewable Energy Sources	5	Exam
OB 3.2.5	Thermal and Nuclear Power Plants	5	Exam
OB 3.2.6	Design, Manufacture and Operation of Heat Engineering Equipment	5	Exam
Total volume of optional components		**27**	
TOTAL VOLUME OF EDUCATIONAL PROGRAM		**90**	

2.2. **Structural-logical scheme of the educational program**



3. FORM OF CERTIFICATION OF APPLICANTS FOR HIGHER

Certification of graduates by the educational program of specialty 144 "Heat-and-Power Engineering" is carried out in the form of the defense of the diploma project and ends with the issuance of the document of the established fashion on awarding the master's degree with qualification: "**Master of Heat and Power Engineering**" in the specializations "**Industrial and Municipal Heat and Power Engineering**" or "**Energy Management and Energy Efficiency**". The certification is carried out openly and publicly.

4. Matrix of correspondence of program competencies to the components of the educational program

	DP 1.1	DP 1.2	DP 1.3	PT2.1.1	PT2.1.2	PT2.1.3	PT2.1.4	PT2.1.5	PT2.1.6	OB 3.1.1	OB 3.1.2	OB 3.1.3	OB 3.1.4	OB 3.1.5	OB 3.1.6	OB 3.2.1	OB 3.2.2	OB 3.2.3	OB 3.2.4	OB 3.2.5	OB 3.2.6
GC1				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC2		+						+								+	+				
GC3	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC4				+					+		+										
GC5										+		+			+						+
GC6		+	+			+															
GC7		+	+													+					
GC8				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GC9	+				+								+						+		
GC10	+				+								+						+		
PC1					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC2					+	+	+		+	+	+			+						+	
PC3								+		+				+	+					+	+
PC4					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC5				+		+							+						+		
PC6						+			+	+						+					
PC7			+	+																	
PC8					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC9		+						+													
PC10				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC11					+																
PC12				+	+	+	+	+	+												
PC13														+	+					+	+
PC14		+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC15					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PCS1-1										+					+						
PCS1-2													+								
PCS1-3											+				+						
PCS1-4										+					+						

PCS1-5										+				+	+						
PCS1-6											+			+							
PCS1-7											+	+									
PCS2-1																+					+
PCS2-2																	+	+	+		
PCS2-3																	+	+			+
PCS2-4																+	+				+
PCS2-5																+				+	+
PCS2-6																	+			+	
PCS2-7																+	+	+	+		
PCS2-8																+		+	+		

5. Matrix to ensure programmed outcomes of learning with relevant components of the educational program

	DP 1.1	DP 1.2	DP 1.3	PT2.1.1	PT2.1.2	PT2.1.3	PT2.1.4	PT2.1.5	PT2.1.6	OB 3.1.1	OB 3.1.2	OB 3.1.3	OB 3.1.4	OB 3.1.5	OB 3.1.6	OB 3.2.1	OB 3.2.2	OB 3.2.3	OB 3.2.4	OB 3.2.5	OB 3.2.6
PRT 1					+					+				+						+	
PRT 2	+				+								+						+		
PRT 3										+						+					
PRT 4				+		+	+	+	+	+	+										
PRT 5	+				+								+						+		
PRT 6		+			+								+				+		+		
PRT 7						+				+					+						+
PRT 8		+																			
PRT 9									+		+	+									
PRT 10					+						+						+	+			
PRT 11														+			+			+	
PRT 12										+					+						+
PRT 13			+				+														
PRT 14										+											
PRT 15							+											+			
PRT 16	+		+																		
PRT 17																+	+				
PRT 18					+		+			+					+						+
PRT 19																+					
PRT 20		+									+						+				
PRT 21								+													
PRT 22						+				+			+		+						+
PRTS 1				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS 2				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS 3				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS 4				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS 5				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+