

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 First (Bachelor) Level

by specialty 144 «Heat-and-Power Engineering»

Area of knowledge 14 «Electrical Engineering»

Qualification: Bachelor 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 First (Bachelor) 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	Bachelor 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

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« ____ » _____ 2019

COORDINATED
Head of the Institute of Power
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Electromechanics

_____ R.S. Tomashevskyi

« ____ » _____ 2019

APPROVED AND PROVIDED

By order No. _____ of the rector of the National Technical University "Kharkiv Polytechnic Institute" from « ____ » _____ 2019

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INTRODUCTION

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

Working group members:

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Head of the support group of the of specialty 144 «Heat-and-Power Engineering»:
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. PROFILE OF THE EDUCATIONAL AND PROFESSIONAL PROGRAM
BY SPECIALTY 144 «HEAT-AND-POWER ENGINEERING»**

1 – General information	
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 - бакалавр Освітня кваліфікація – бакалавр з теплоенергетики Кваліфікація в дипломі - бакалавр 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 First (Bachelor) Level of higher education
Type of diploma and extent of educational program	Bachelor's degree, individual, 240 ECTS credits, 4 years of training
Availability of accreditation	Protocol No. 116, order No. 1415/ of 10.06.2015.
Cycle / program level	FQ-EHEA – first cycle, QF LLL – 6 level, NQF Ukraine – 1 level
Prerequisites	Full secondary education
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	
<p>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, humanitarian, fundamental and professional fields. The achievement of the stated goal is based on the principles of continuity and individualization of learning, the fundamentality and integrity of knowledge, practical orientation and awareness of the place of the received competencies, symbiosis of scientific and system approaches, etc.</p> <p>Training of specialists who are able to carry out designing and calculation of modern heat and power systems independently; to determine the optimal parameters of thermalphysic devices of different power and purpose on the basis of a comprehensive analysis; to carry out engineering works in the sphere of energy-efficient technologies that are going to reduce using of different fuel types, to increase environmental safety and efficiency of heat energy transformation.</p>	
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 educational-professional program is aimed for the achievement by students the knowledge in the research, design, construction, operation, installation, repair and modernization of technical means for the production of heat, electricity and cold, application, flow management and interconversion of other types of energy and heat, process automation; increasing the energy efficiency of the facility on

	the basis of energy audit by proposing and substantiate energy saving measures that lead to a reduction of fuel and energy consumption, organization and maintaining of a system of energy management at industrial and municipal enterprises.
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 bachelor'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 bachelor'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 fundamental 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. A graduate may hold positions of specialist, primary (junior) engineer and manager (grassroots management): power engineering specialist, production power engineer, district power engineer, workshop power engineer, operator of diesel and refrigeration units, technical equipment maintenance and repair specialist, technical specialist for adjustment and testing of equipment, technical expert-heat engineer, state inspector for energy supervision over the rates of consumption of electric and heat energy. Upon gaining an industrial experience and passing the examinations to confirm the availability of the required professional knowledge, skills and abilities, the graduate can work on the engineering positions of the relevant units of the heat power companies, design organizations.
Further education	Possibility of continuing education at the next (master's) level of higher education (level 7 by NQF Ukraine, the second cycle of FQ-EHEA and level 7 of EQF-LLL) by the corresponding educational-professional or educational-scientific programs. Possibility of postgraduate education to obtain professional qualifications in accordance with the relevant professional standards.
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	<p>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.</p> <p>Rating system of assessment, oral and written examinations, testing.</p> <p>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.</p>
6 – Program competencies	
Integral competence	Ability to solve complex specialized problems 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)	<p>GC-1. Ability to learn and master modern knowledge.</p> <p>GC-2. Ability to apply knowledge in practical situations.</p> <p>GC-3. Skills of using information and communication technologies.</p> <p>GC-4. Ability to search, process and analyze information from various sources.</p> <p>GC-5. Ability to work in a team.</p> <p>GC-6. Ability to communicate in the state language both verbally and in writing.</p> <p>GC-7. Ability to make informed decisions.</p> <p>GC-8. Ability to communicate in a foreign language.</p> <p>GC-9. Ability to master the basics of historical thinking, to have an idea of history as a science, its place in the system of humanities, to know the historical sources.</p> <p>GC-10. To have an idea of the peculiarity of philosophy, its place in culture, science, philosophical and religious views of the universe, the essence, purpose and meaning of human life, the forms and methods of scientific knowledge.</p> <p>GC-11. Understand the essence of culture, its place and role in the life of man and society, have understanding of the forms of culture, their origin and development, the creation of cultural norms and values, the mechanisms of preservation and transfer of them as a socio-cultural experience, to know the main achievements in various areas of cultural practice.</p> <p>GC-12. Ability to demonstrate basic knowledge in the field of natural sciences and readiness to use the methods of fundamental sciences for solving general engineering and professional problems.</p> <p>GC-13. Ability and readiness to understand and analyze economic problems and social processes, to be an active subject of economic activity.</p> <p>GC-14. Ability to have information about the unity of all ecological systems of the biosphere, methods of detecting changes in environmental parameters under the influence of human activity.</p>
Professional competence (PC) (Determined by the standard of	PC-1. Ability to apply appropriate quantitative mathematical, scientific and technical methods, and computer software for solving

<p>higher specialty education)</p>	<p>engineering problems in the heat engineering industry.</p> <p>PC-2. Ability to apply and integrate knowledge and understanding of other engineering disciplines.</p> <p>PC-3. Ability to demonstrate practical engineering skills in the design and operation of heat and power equipment.</p> <p>PC-4. Ability to demonstrate knowledge and understanding of the mathematical principles and methods required in the heat engineering industry.</p> <p>PC-5. Ability to identify, classify and describe the effectiveness of systems and components based on the use of analytical methods and simulation methods in the heat engineering industry.</p> <p>PC-6. Ability to investigate and identify the problem and identify limitations, including those related to environmental protection, stable development, health and safety, and to estimate risk in the heat engineering sector.</p> <p>PC-7. Ability to demonstrate knowledge and understanding of the commercial and economic context in the heat engineering industry.</p> <p>PC-8. Ability to demonstrate understanding of the broader interdisciplinary engineering context and its core principles.</p> <p>PC-9. Ability to demonstrate understanding of the matter of the use of technical literature and other sources of information in the heat engineering industry.</p> <p>PC-10. Ability to develop plans and projects to achieve a specific goal, taking into account all aspects of the problem to be solved, including the production, operation, maintenance and utilization of heat and power equipment.</p> <p>PC-11. Ability to demonstrate an understanding of the need to keep to professional and ethical standards of high-level activities in the heat engineering industry.</p> <p>PC-12. Ability to demonstrate an understanding of the quality problems in the heat engineering industry.</p> <p>PC-13. Ability to demonstrate knowledge of the characteristics and properties of materials, equipment, processes in the heat engineering industry.</p> <p>PC-14. Ability to demonstrate awareness of intellectual property and contracts in the heat engineering industry.</p>
<p>Professional competencies of specialization (Determined by the institution of higher education) (PCS)</p>	<p>PCS1-1. Readiness to participate in the collection and analysis of source data for the design of elements of heat and power equipment and facilities in general, using regulatory documentation and modern methods of information retrieval and processing.</p> <p>PCS1-2. Ability to make calculations according to standard methods and design separate parts and units of heat and power equipment using standard design automation tools in accordance with the technical specification.</p> <p>PCS1-3. Ability to perform measurements and observations, compilation of the description of the performed research, preparation of data for the compilation of reviews, reports and scientific publications.</p> <p>PCS1-4. Ability to participate in the development of design and working technical documentation, completion of design and development work in accordance with standards, specifications and other regulatory documents.</p>

PCS1-5. Ability to use standard methods of control over operation modes of heat and power equipment.

PCS1-6. Ability to participate in typical, planned tests and repairs of heat and power equipment, installation, adjustment and commissioning works.

PCS1-7. Ability to participate in work on the estimation of the technical condition and residual life of heat and power equipment, in the organization of preventive examinations and the ongoing repair of equipment.

PCS1-8. The ability to formulate a task for the development of design solutions related to the modernization of heat and power equipment, and measures for improving operational characteristics, increasing environmental safety, improving working conditions, and saving resources.

PCS2-1. Ability to analyze the prerequisites for the creation and implementation of a system of energy management at industrial enterprises and utilities.

PCS2-2. Ability to participate in performing a preliminary technic and economic reasoning on energy efficiency of design work according to standard methods.

PCS2-3. Ability to develop proposals for maintenance of heat and power equipment, to prepare of requests for equipment and spare parts, technical documentation for repairs.

PCS2-4. Ability to participate in the development and implementation of energy saving and energy efficiency measures.

PCS2-5. Ability to evaluate and test new energy efficient equipment and its applicability.

PCS2-6. Ability to analyze data sets on fuel and energy consumption, production volumes, to forecast and evaluate energy efficiency using modern methods of information processing.

PCS2-7. Ability to develop and implement personnel motivation system for energy and resource conservation.

PCS2-8. Ability to manage the consumption of fuel and energy in industrial enterprises and municipal areas.

7 – Programmed results of training

Programmed results of training in the specialty (defined by the standard of higher education by specialty) (PRT)

PRT-1. The knowledge and understanding of mathematics, physics, chemistry, gas dynamics, heat and mass transfer, technical thermodynamics, strength, transformation of energy, technical mechanics, which are the basis of the specialty "Heat-and-Power Engineering" of the corresponding specialization, at the level necessary for the achievement of educational program results.

PRT-2. Knowledge and understanding of engineering disciplines underlying the specialty "Heat-and-Power Engineering" of the corresponding specialization, at the level necessary for achieving other results of the educational program, including certain knowledge in the latest achievements of science and technology.

PRT-3. Understanding the interdisciplinary context of the specialty "Heat-and-Power Engineering".

PRT-4. Ability to understand complex engineering technologies, processes, systems and equipment according to the specialty "Heat-and-Power Engineering"; to select and apply suitable standard analytical, computational and experimental methods; correctly interpret the results of such studies.

PRT-5. Ability to identify, formulate and solve engineering tasks in relative to the specialty "Heat-and-Power Engineering"; understanding the importance of non-technical (social, health, safety, and environment-bounded, economic and industrial) restrictions.

PRT-6. Ability to work out and design complex products in the heat engineering 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; the selection and application of an adequate design methodology.

PRT-7. Ability to use certain understanding of advanced achievements when designing objects in the heat engineering industry.

PRT-8. Ability to search the necessary information in the technical literature, to use scientific databases and other relevant sources of information, to carry out simulations for the purpose of detailed study and research of engineering issues of the specialty "Heat-and-Power Engineering" of the corresponding specialization.

PRT-9. Ability to apply the codes of practice and safety rules for the specialty "Heat-and-Power Engineering" of the corresponding specialization.

PRT-10. Laboratory / technical skills and ability to plan and carry out experimental research using instrumental means (measuring instruments), to estimate the errors of research having been performed, to draw conclusions.

PRT-11. Ability to demonstrate a systematic understanding of key aspects and concepts in the heat engineering industry, technology of production, transportation, distribution and use of energy.

PRT-12. Understanding the design and research techniques being applied, as well as their limitations in accordance with the specialties of the specialty "Heat-and-Power Engineering".

PRT-13. Practical skills in solving problems involving the implementation of engineering projects and research in accordance with the specialization.

PRT-14. Understanding of used materials, equipment and tools,

	<p>engineering technologies and processes, as well as their limitations in accordance with the specialties of the specialty "Heat-and-Power Engineering".</p> <p>PRT-15. Ability to apply the rules of engineering practice in accordance with the specialties of the specialty "Heat-and-Power Engineering".</p> <p>PRT-16. Understanding of non-technical (social, health, safety, and environment-bounded, economic and industrial) consequences of engineering practice.</p> <p>PRT-17. Ability to collect and interpret relevant data and analyze the complexity within the corresponding specialization of the specialty "Heat-and-Power Engineering" for the presentation of judgments that reflect relevant social and ethical issues.</p> <p>PRT-18. Ability to manage professional activity, take part in work on projects in accordance with the specialties of the specialty "Heat-and-Power Engineering", assuming responsibility for decision-making.</p> <p>PRT-19. Ability to communicate effectively over questions of information, ideas, problems and solutions.</p> <p>PRT-20. Ability to work effectively with the engineering community and society as a whole in the national and international context as a personality and as a member of a team, and to cooperate effectively with engineers and engineers.</p> <p>PRT-21. Ability to recognize the need in self-study and perform it throughout life.</p> <p>PRT-22. Ability to track the development of science and technology.</p>
<p>Programmed results of training in a specialty (defined by the institution of higher education) (PRTS)</p>	<p>PRTS 1. Understanding the design and research techniques 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".</p> <p>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.</p> <p>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".</p> <p>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.</p> <p>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".</p>
<p>8 – Resource support for the implementation of the program</p>	
<p>Peopeware</p>	<p>It meets the personnel requirements for ensuring the</p>

	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.

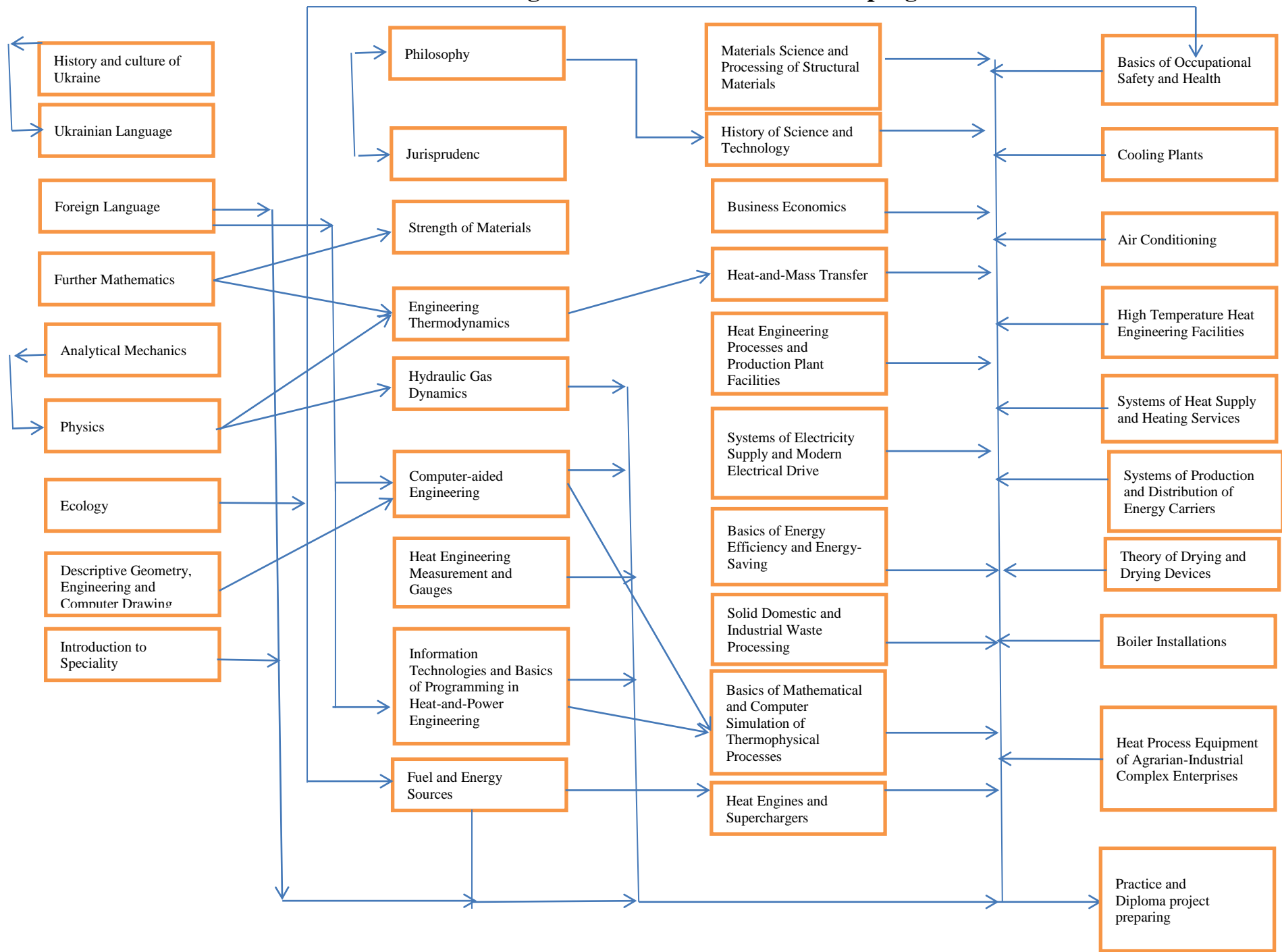
2. LIST OF EDUCATIONAL PROGRAM COMPONENTS

Code	Educational program components (disciplines, projects / work, practice, qualification work)	Credits ECTS	Form of final control
1	2	3	4
MANDATORY COMPONENTS OF THE EDUCATIONAL PROGRAM			
1. General training cycle			
GT 1.1	Ukrainian Language	3	Exam
GT 1.2	History and culture of Ukraine	4	Exam
GT 1.3	Jurisprudence	3	Test
GT 1.4	Foreign Language	12	Test (1-3,7), Exam
GT 1.5	Philosophy	3	Exam
GT 1.6	Further Mathematics	19	Exam
GT 1.7	Physics	13	Exam
GT 1.8	Chemistry	4	Test
GT 1.9	Ecology	3	Test
GT 1.10	Physical Education 1-6	12	Test (1-6)
2. Professional and practical training cycle			
2.1. Professional training in specialty			
PT 2.1.1	Descriptive Geometry, Engineering and Computer Drawing	6	Exam (1) Test (2)
PT 2.1.2	Analytical Mechanics	5	Exam
PT 2.1.3	Materials Science and Processing of Structural Materials	3	Exam
PT 2.1.4	Strength of Materials	5	Exam
PT 2.1.5	Engineering Thermodynamics	10	Test (1) Exam (2)
PT 2.1.6	Hydraulic Gas Dynamics	4	Test
PT 2.1.7	History of Science and Technology	3	Test
PT 2.1.8	Basics of Occupational Safety and Health	3	Exam
PT 2.1.9	Computer-aided Engineering	4	Test
PT 2.1.10	Heat Engineering Measurement and Gauges	6	Exam
PT 2.1.11	Introduction to Speciality	3	Test
PT 2.1.12	Business Economics	3	Test
2.2. Practical training in specialty			
PT 2.2.1	Practice	6	Test
PT 2.2.2	diploma project preparing (DP)	6	Defence of DP
Total volume of mandatory components		143	

Code	Educational program components (disciplines, projects / work, practice, qualification work)	Credits ECTS	Form of final control
1	2	3	4
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	Information Technologies and Basics of Programming in Heat-and-Power Engineering	10	Exam, Test
OB 3.1.2	Fuel and Energy Sources	4	Exam
OB 3.1.3	Heat-and-Mass Transfer	10	Exam
OB 3.1.4	Heat Engineering Processes and Production Plant Facilities	9	Exam, Test
OB 3.1.5	Cooling Plants	4	Exam
OB 3.1.6	Heat Engines and Superchargers	4	Exam
OB 3.1.7	Air Conditioning	4	Exam
OB 3.1.8	Systems of Electricity Supply and Modern Electrical Drive	4	Test
OB 3.1.9	High Temperature Heat Engineering Facilities	4	Exam
OB 3.1.10	Basics of Energy Efficiency and Energy-Saving	4	Exam
OB 3.1.11	Systems of Heat Supply and Heating Services	5	Exam
OB 3.1.12	Systems of Production and Distribution of Energy Carriers	5	Exam
OB 3.1.13	Theory of Drying and Drying Devices	3	Exam
OB 3.1.14	Solid Domestic and Industrial Waste Processing	4	Test
OB 3.1.15	Heat Process Equipment of Agrarian-Industrial Complex Enterprises	3	Exam
OB 3.1.16	Basics of Mathematical and Computer Simulation of Thermophysical Processes	3	Exam
OB 3.1.17	Boiler Installations	5	Exam
Discipline block 3.2. «Energy management and energy efficiency»			
OB 3.2.1	Information Technologies and Basics of Programming in Heat-and-Power Engineering	10	Exam, Test
OB 3.2.2	Fuel and Energy Sources	4	Exam
OB 3.2.3	Heat-and-Mass Transfer	10	Exam
OB 3.2.4	Heat Engineering Processes and Production Plant Facilities	9	Exam, Test
OB 3.2.5	Cooling Plants	4	Exam
OB 3.2.6	Heat Engines and Superchargers	4	Exam
OB 3.2.7	Air Conditioning	4	Exam
OB 3.2.8	Systems of Electricity Supply and Modern Electrical Drive	4	Test
OB 3.2.9	High Temperature Heat Engineering Facilities	4	Exam
OB 3.2.10	Basics of Energy Management	4	Exam
OB 3.2.11	Systems of Heat Supply and Heating Services	5	Exam
OB 3.2.12	Systems of Production and Distribution of Energy Carriers	5	Exam
OB 3.2.13	Basics of Energy Monitoring	3	Exam

OB 3.2.14	Modern Requirements for Energy Efficiency and Environmental Safety	4	Test
OB 3.2.15	Heat Process Equipment of Agrarian-Industrial Complex Enterprises	3	Exam
OB 3.2.16	Basics of Mathematical and Computer Simulation of Thermophysical Processes	3	Exam
OB 3.2.17	Boiler Installations	5	Exam
4. Optional disciplines for choose by student			
OS 4.1.1	Optional discipline 1	4	Test
OS 4.1.2	Optional discipline 2	4	Test
OS 4.1.3	Optional discipline 3	4	Test
Total volume of optional components		97	
TOTAL VOLUME OF EDUCATIONAL PROGRAM		240	

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 bachelor's degree with qualification: "**Bachelor 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.

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

	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 3.1.7	OB 3.1.8	OB 3.1.9	OB 3.1.10	OB 3.1.11	OB 3.1.12	OB 3.1.13	OB 3.1.14	OB 3.1.15	OB 3.1.16	OB 3.1.17	OB 3.2.1	OB 3.2.2	OB 3.2.3	OB 3.2.4	OB 3.2.5	OB 3.2.6	OB 3.2.7	OB 3.2.8	OB 3.2.9	OB 3.2.10	OB 3.2.11	OB 3.2.12	OB 3.2.13	OB 3.2.14	OB 3.2.15	OB 3.2.16	OB 3.2.17			
GC1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
GC2	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
GC3			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
GC4	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
GC5	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
GC6	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
GC7	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
GC8																																					
GC9	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
GC10																																					
GC11																																					
GC12	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
GC13	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
PC1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
PC2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
PC3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
PC4	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC5	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC6										+	+																										
PC7										+		+					+																				
PC8	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC9	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC10	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC11	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC12	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC13	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PC14	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PCS1.1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
PCS1.2	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PCS1.3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

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

	GT 1.1	GT 1.2	GT 1.3	GT 1.4	GT 1.5	GT 1.6	GT 1.7	GT 1.8	GT 1.9	PT 2.1.1	PT 2.1.2	PT 2.1.3	PT 2.1.4	PT 2.1.5	PT 2.1.6	PT 2.1.7	PT 2.1.8	PT 2.1.9	PT 2.1.10	PT 2.1.11	PT 2.1.12	PT 2.2.1	PT 2.2.1	
PRT1						+	+	+			+			+	+									
PRT2														+						+	+			
PRT3	+	+		+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT4									+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT5					+				+								+					+		
PRT6										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT7										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT8										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT9										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT10										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT11										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT12										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT13										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT14										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT15										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT16										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT17										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT18										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT19	+	+		+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT20	+	+		+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT21	+	+		+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT22										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRT16										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS1										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS2										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS3										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS4										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
PRTS5										+	+	+	+	+	+	+	+	+	+	+	+	+	+	+