

MINISTRY OF SCIENCE AND EDUCATION OF UKRAINE

**NATIONAL TECHNICAL UNIVERSITY
«KHARKIV POLYTECHNIC INSTITUTE»**

APPROVED

Rector of NTU “KhPI”

_____ E. Sokol

«____» _____ 2019 p.

EDUCATIONAL PROFESSIONAL PROGRAM

«Chemical technologies and engineering»

Of the first (bachelor) level of the higher education

For speciality 161 Chemical technologies and engineering

Field of knowledge 16 Chemical and bioengineering

Qualification: Bachelor of chemical technologies and engineering

APPROVED BY

ACADEMIC COUNCIL OF NTU “KhPI”

Head of academic council

_____ L. Tovazhnyanskyy

Protocol № _____

«____» _____ 2019.

Kharkiv 2019

APPROVEMENT SHEET OF Scientific-educational program

Level of higher education	First (bachelor)
Field of knowledge	16 Chemical and bioengineering
Speciality	161 Chemical technologies and engineering
Specializations	161-01 Chemical technologies of inorganic substances 161-03 Technical Electrochemistry 161-04 Chemical technologies of Ceramics, Refractory Materials, Glass and Enamels 161-06 Chemical technologies of processing of plastic Mass and Biologically Active Polymers 161-07 Technology of polymers for medical, pharmaceutical, food industry 161-08 Technology of paints and polymer coatings 161-09 Chemical technologies of rare and trace elements and materials on their base 161-11 Integration of technological processes, software of energy efficiency
Qualification	Bachelor of chemical technologies and engineering

Vice-rector for Scientific-and-Pedagogical Work	R.P. Mygushchenko
Director of Institute of Education and Science in Chemical Technologies and Engineering,	I.M. Ryshenko
Head of department	G.G. Tulskiy
Head of department	Y.M. Pytak
Head of department	V.L. Avramenko
Head of department	O.M. Tsygankov
Head of department	V.E. Ved

APPROVED BY

Order of rector of National technical university "Kharkiv polytechnic institute" «_____»
_____20__ year. № _____.

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Polytechnic Institute".***

PREAMBLE

Created by the project group of Institute of Education and Science in Chemical Technologies and Engineering, National Technical University "Kharkiv Polytechnic Institute":

1. O.V.Kobzev, candidate of technical sciences, head of department of technologies of inorganic substances, catalysis and ecology
2. G.G.Tulskiy, doctor of technical sciences, professor, head of department of technical electrochemistry
3. Y.M. Pytak, doctor of technical sciences, professor, head of department of Ceramics, Refractory Materials, Glass and Enamels
4. V.L. Avramenko, candidate of technical sciences, professor, head of department of technology of plastic mass and biologically active polymers
5. O.V. Tsygankov, doctor of technical sciences, head of department of Organic chemistry, Biochemistry, Glass and Enamels
6. V.E. Ved, doctor of technical sciences, professor, head of department of Integrated technologies, Processes and Apparatus

The current program has been created for temporary implementation, before the introduction of the standard of the first (Bachelor) level of higher education in the specialty "Chemical technologies and engineering".

Reviewers:

1. Goleus V.I, Ph.D., Professor, First Vice-Rector, State Higher Educational Institution "Ukrainian State Chemical-Technological University".
2. Astrelin I.M., Doctor of Technical Sciences, Professor, Dean of the Faculty of Chemical Technology, National Technical University of Ukraine "Igor Sikorsky Polytechnic Institute".
3. Kuntiyi O.I, Doctor of Technical Sciences, Professor, Professor of the Department of Chemistry and Technology of Inorganic Substances, National University "Lviv Polytechnic".
4. Sklabinsky V.I., Doctor of Technical Sciences, Professor, Head of the Department of Processes and Equipment for Chemical and Petroleum Processing Industries, Sumy State University.
5. State Higher Educational Institution "Ukrainian State Chemical-Technological University".

Reviews of external stakeholders:

1. PLC "UKRNDIKHIMMASH", Kharkiv.
2. State Research and Design Institute of Basic Chemistry "NIOCHIM", Kharkiv.
3. JSC "Ukrainian Research Institute of refractories named after A.S. Berezhnogo »
4. LLC "Faydal Ukraine", Kyiv.
5. Research department of Open Society "Polisan", Sumy.
6. LLC Industrial Enterprise "ZIP", city of Kamensk
7. ISM NAS of Ukraine, Kharkiv.
8. IPMash NAS of Ukraine, Kharkiv.

**1. PROFESSIONAL EDUCATIONAL SPECIALIZED PROGRAM
FOR SPECIALTY 161 CHEMICAL TECHNOLOGIES AND ENGINEERING**

1 – General information	
Full name of university and department	National Technical University "Kharkiv Polytechnic Institute" Institute of Education and Science in Chemical Technologies and Engineering
Level of higher education and qualification name in original language	Bachelor of chemical technologies and engineering Бакалавр з хімічних технологій та інженерії
Official name of professional educational specialized program	Professional educational specialized program For specialty 161 Chemical technologies and engineering
Type of diploma and volume of educational program	Bachelor diploma, unitary, 240 credits , 4 year
Accreditation	Program has been implemented in 2017
Level of National Qualification Framework	FQ-EHEA – first cycle, QF LLL – 6 level, HPK – 7 level
Prerequisites	Completed secondary education
Language of teaching	Ukrainian / English
Duration of educational program	Until next accreditation
Link for the permanent placement of educational program	http://web.kpi.kharkov.ua/xtnv/uk/ , http://web.kpi.kharkov.ua/dte/uk/ , http://web.kpi.kharkov.ua/ceramic/uk/ , http://web.kpi.kharkov.ua/tpm/ , http://web.kpi.kharkov.ua/orgchem/ , http://web.kpi.kharkov.ua/itpa/ .
2 – Aim of educational program	
Training of specialists capable of solving complex specialized problems and practical problems related to the development, production, research and / or certification of chemicals, materials and products based on them, as well as relevant technological processes.	
3 – Characteristics of the educational program	
Subject area (field of knowledge, specialty, specialization)	Field of knowledge: 16 Chemical and bioengineering Specialty: 161 Chemical Technology and Engineering Specializations: 161-01 Chemical technologies of inorganic substances 161-03 Technical Electrochemistry 161-04 Chemical technologies of refractory non-metal and silicate materials 161-06 Chemical technology for the processing of polymeric and composite materials 161-07 Polymer technology for the medical, pharmaceutical, food and consumer industries 161-08 Technology of paint and varnish materials and polymeric coatings 161-09 Chemical technologies of rare scattered elements and materials on their basis 161-11 Integration of technological processes, energy efficiency software
Orientation of the educational program	Technological processes and apparatuses for the production of chemicals, as well as materials and products based on them. Professional orientation - development and control of technological processes of chemical technology. Selection and calculation of

	equipment. Organization of production.
The main focus of the educational program and specialization	Concepts, laws and methods of mathematics, physics and chemistry used in chemical engineering; modeling and physico-chemical bases of chemical production; conceptual bases of technological processes realization; calculation and design of machines and apparatuses of the chemical industry.
Features of the program	A professional-oriented program is based on the preparation of basic and socio-humanitarian disciplines, which allows you to acquire professional competencies, both in the basic and related specialties. Compulsory practice in manufacturing by specialty.
4 - Eligibility of graduates to employment and further training	
Suitability for employment	Employment at enterprises, companies, research institutions of the chemical, pharmaceutical, machine-building industries. Professional opportunities for graduates (according to the Classifier of professions DK 003: 2010): 3119 technologist; 3119 trainee researcher 3111 technician and technologist 3116 electrochemical protection technician 3116 technician (chemical technology) 3116 technician laboratory assistant (chemical production) Continuation of education by the second (master's) level of higher education
Further training	Continuation of education by the second (master's) level of higher education
5 – Teaching and rating	
Teaching and learning	Lectures, laboratory and practical classes, implementation of term papers and projects, independent work and self-study, practice, preparation of qualifying work.
Rating	Current and final knowledge control (surveys, control and individual tasks, testing, etc.), credits and exams (oral and written), public defense of qualification work.
6 – Program competencies	
Integral competence	Ability to solve complex specialized problems and practical problems with chemical technologies and engineering in the process of training, which involves the application of certain theories and methods of chemical engineering and characterized by complexity and uncertainty of the conditions.
General Competence (GC)	GC–1 Ability to apply knowledge in practical situations. GC – 2 Ability to plan and manage time. GC – 3 Knowing and understanding of the subject area of professional activity. GC – 4 Ability to communicate in the state language both verbally and in writing. GC – 5 Ability to communicate in a foreign language. GC – 6 Skills of using information and communication technologies.

	GC – 7 Valuation and Respect for Diversity and Multiculturalism. GC – 8 Skills for safe operation. GC – 9 Determination and persistence on the tasks and duties taken. GC – 10 The striving to save the environment. GC – 11 Ability to identify, put and solve problems. GC – 12 Ability to learn and master modern knowledge.
Special (professional) competencies (SC)	SC-1. Ability to demonstrate knowledge and understanding of the basic facts, concepts, principles and theories related to chemical technology and engineering. SC-2. Ability to use methods of observation, description, identification, classification of objects of chemical technology and industrial products. SC-3. Ability to read, write and present documents, as well as communicate with other specialists and scientists in a foreign language. SC-4. Ability to use knowledge and understanding of the general chemical technology, processes and apparatuses of chemical industries for the analysis, evaluation and design of technological processes and equipment. SC-5. The ability to process and interpret data relating to chemical technology and engineering, correlating them with relevant theories. SC-6. Ability to choose and use appropriate equipment, tools and methods for the implementation and control of chemical production. SC-7. Ability to use computer technology and information technology to solve practical problems in the field of chemical engineering. SC-8. Ability to take into account the commercial and economic context in the design of chemical production. SC-9. Ability to process the results of experiments using modern statistical methods and software. SC-10. Skills of safe handling of chemical materials, taking into account their physical and chemical properties, including the dangers associated with their use. SC-11. Ability to execute scientific and technical documentation in accordance with current requirements.
Professional competencies of specialization (defined by the institution of higher education) (PCS)	Block 161-01 Chemical Technology of Inorganic Substances PCS-1 Ability to demonstrate knowledge and understanding of the concepts, principles and theories that belong to the theoretical foundations of inorganic substances technology. PCS-2 Ability to use knowledge and understanding of the physical and chemical properties of raw materials and finished products. PCS-3 Ability to choose and apply natural water treatment methods to meet production needs. PCS-4 Ability to apply methods of analytical and instrumental control of the properties and composition of substances and materials. PCS-5 Ability to use knowledge and understanding of the basics of industrial catalysis. PCS-6 Ability to demonstrate knowledge and understanding of the basics of selecting the necessary and sufficient technological stages for obtaining inorganic products.

	PCS-7 Ability to choose, calculate and apply equipment of inorganic substances technology. Ability to use knowledge and understanding in mathematical modeling and optimization of chemical and technological processes. PCS-8 Ability to choose and apply automated design methods. PCS-9 Ability to use resource-saving technologies
	Block 161-03 Technical Electrochemistry
	PCS-1. Ability to demonstrate knowledge and understanding of the concepts, principles and theories related to theoretical electrochemistry. PCS-2. Ability to use knowledge and understanding of physico-chemical and tribological properties of materials. PCS-3. Ability to apply electrochemical systems in power engineering. PCS-4. Ability to apply electrochemical systems in methods of analysis. PCS-5. Ability to demonstrate knowledge and understanding of the concepts, principles and theories related to technical electrochemistry. PCS-6. Ability to demonstrate knowledge and understanding of concepts, principles and theories related to chemical resistance of materials and corrosion protection. PCS-7. Ability to choose and apply equipment of electrochemical manufactures. PCS-8 Ability to use knowledge and understanding of the design of electrochemical industries. PCS-9. Ability to choose and apply automated design methods. PCS-10 Ability to use resource-saving technologies.
	Block 161-04 Chemical technologies of refractory non-metal and silicate materials
	PCS-1. Ability to demonstrate knowledge and understanding of the concepts, principles and theories related to technologies of refractory non-metal and silicate materials. PCS-2. Ability to use knowledge and understanding of the internal structure and physical and chemical properties of materials. PCS-3. Ability to apply physico-chemical oxide systems in technologies of refractory non-metal and silicate materials. PCS-4. Ability to apply thermodynamic methods of analysis in technologies of refractory non-metal and silicate materials. PCS-5. Ability to demonstrate knowledge and understanding of the concepts, principles and theories related to the physical chemistry of silicates. PCS-6. Ability to apply petrographic and physico-mechanical methods of analysis in technologies of refractory non-metallic and silicate materials. PCS-7. Ability to choose and apply equipment of production of refractory non-metal and silicate materials. PCS-8 Ability to use knowledge and understanding of the design of production of refractory non-metal and silicate materials. PCS-9. Ability to choose and apply automated design methods. PCS-10 Ability to use resource and energy saving technologies.
	Block 161-06 Chemical processing technology of polymeric and composite materials
	PCS-1. The ability to substantiate the choice of technical and technological means for the implementation of the industrial process for the processing of polymer and composite materials.

	PCS-2. Ability to choose the main and auxiliary equipment for the implementation and control of the technological process for the production of monomers and the processing of polymer and composite materials. PCS-3. Ability to calculate optimal variants of technological, material, energy-thermal and other flows for the production of monomers and processing of concrete polymer composite material. PCS-4. Ability to use knowledge of the latest technologies for the processing of polymer composite materials for the solution of the production problem. PCS-5. Ability to understand the commercial and economic context, to assess the safety of designing a process for the processing of polymer composite material. PCS-6. Understanding the environmental and social implications of their professional activities. PCS-7. Ability to choose and apply automated design methods. PCS-8 Ability to use resource-saving technologies.
	Block 161-07 Polymer Technology for the Medical, Pharmaceutical, Food and Life Sciences
	PCS-1. Ability to substantiate the choice of technical and technological means for realization of the industrial process for the production of monomers and synthetic and natural polymers and elastomers for the medical, pharmaceutical, food industries and everyday life. PCS-2. Ability to choose the main and auxiliary equipment for the implementation and control of the technological process for the production of monomers and synthetic and natural polymers and elastomers for the medical, pharmaceutical, food industries and everyday life. PCS-3. Ability to calculate optimal variants of technological, material, energy thermal and other streams of synthetic and natural polymers and elastomers for the medical, pharmaceutical, food industries and everyday life. PCS-4. Ability to use knowledge of the latest technologies for the production of synthetic and natural polymers and elastomers for the solution of the production task. PCS-5. Ability to understand the commercial and economic context, to assess the safety of the design process of the production of synthetic and natural polymers and elastomers. PCS-6. Understanding the environmental and social implications of their professional activities. PCS-7. Ability to choose and apply automated design methods. PCS-8 Ability to use resource-saving technologies.
	Block 161-08 Technology of paint and varnish materials and polymeric coatings
	PCS-1. Ability to demonstrate knowledge and understanding of theories, concepts and principles of organic chemistry in forecasting optimal methods and approaches to the synthesis of polymer film formers and other substances of organic origin. PCS-2. Ability to demonstrate knowledge and understanding about the choice and prediction of the influence of the pigment component on the performance of paint and varnish materials. PCS-3. Ability to demonstrate knowledge and understanding about the

	theoretical foundations of obtaining macromolecular compounds, regulation and prediction of their properties. PCS-4. Ability to choose methods of chemical analysis for the purpose of determination, regulation and prediction of the properties of polymer composite materials, and cover them on the basis. PCS-5. Ability to demonstrate knowledge about forecasting of properties, selection and substantiation of modern approaches to compilation of formulations, ways of optimization of chemical and technological processes of the production of progressive polymer film formers. PCS-6. Knowledge and understanding of the basic principles of the physics of polymers and the differences in their physical properties from low molecular weight compounds. PCS-7. Ability to demonstrate knowledge and understanding of the regularities of modern technological processes of obtaining polymers, optimization of technological parameters and technical means of their manufacture in order to regulate the properties of polymers. PCS-8 Ability to demonstrate knowledge and understanding of the main colloid and chemical properties of polymer disperse systems. PCS-9. Ability to choose and apply equipment for the production of polymers in particular, film formers in the paintwork. PCS-10 Ability to use knowledge and understanding of the design of paint and varnish industries. PCS-11. Ability to demonstrate knowledge and understanding of general theoretical and practical approaches to the selection of prescription components, preparation of formulations, regulation of the properties of artistic and printing inks. PCS-12. Ability to demonstrate knowledge and understanding about forecasting of properties, selection and substantiation of modern approaches to compilation of recipes, ways of optimization of technological processes of manufacturing of modern pigmented paint and varnish materials. PCS-13. Knowledge and understanding of the features of physical and chemical processes that occur during the formation of thin-layer adhesive paint and varnish coatings. PCS-14. Ability to choose and apply equipment for the production of pigmented paint and varnish materials. PCS-15 Ability to demonstrate knowledge and understanding of the application of the basic conceptual provisions of biochemistry in the technology of obtaining polymer coatings.
	Block 161-09 Chemical technologies of rare scattered elements and materials on their basis
	PCS-1. Ability to demonstrate knowledge and understanding of concepts, principles and theories that belong to the theoretical foundations of the chemistry of rare scattered elements. PCS-2. Ability to use knowledge and understanding of physico-chemical and tribological properties of materials on the basis of rare scattered elements. PCS-3. Ability to apply materials based on rare scattered elements in the power industry. PCS-4. Ability to apply analysis methods for materials based on rare scattered elements.

	PCS-5. Ability to demonstrate knowledge and understanding of the concepts, principles and theories related to the chemical technologies of rare scattered elements and materials on their basis. PCS-6. Ability to demonstrate knowledge and understanding of concepts, principles and theories related to chemical resistance of materials and corrosion protection. PCS-7. Ability to choose and apply equipment of chemical technologies of rare scattered elements and materials on their basis. PCS-8 Ability to use knowledge and understanding of the design of chemical production of rare scattered elements and materials on their basis. PCS-9. Ability to choose and apply automated design methods. PCS-10 Ability to use energy-saving technologies of rare scattered elements and materials on their basis.
	Block 161-11 Integration of technological processes, energy efficiency software
	PCS-1. Ability to design project documents using computer graphics and standards. PCS-2. Ability to carry out analysis of technological objects in terms of the basic typical processes of chemical technology, using the methods of physical and mathematical modeling, experimental research data, engineering calculation methods. PCS-3. Ability to use methods of determining the basic physical parameters of technological processes of objects of the industry for engineering calculations of operating modes of equipment. PCS-4. The ability to use devices to measure physical characteristics that characterize the process for conducting experimental research and to process measurement results using modern means of information processing. PCS-5. Ability to use the basics of modeling, design, operation, performance control of computer-integrated systems that implement the principles of optimizing the cost of energy carriers and natural resources PCS-6. Ability to form computer models of chemical and technological systems with the help of modern software for optimization of investigated processes in stationary and dynamic conditions. PCS-7. Ability to analyze the capabilities of chemical and technological systems in the aspect of carrying out a set of measures to minimize energy consumption, in particular, the use of renewable energy sources and secondary energy resources PCS-8 Possession of modern methods of optimization of energy consumption of chemical and technological systems with the use of appropriate specialized software PCS-9. The ability to design automated energy-saving systems and complexes, using modern approaches to minimize energy consumption by creating networks of heat exchangers with maximum energy recovery PCS-10 Ability to implement minimization of energy and resources costs in technological processes by optimizing their use.
7 - Program learning outcomes	
Program results of training in a specialty (defined by the	PR-1. Ability to demonstrate conceptual knowledge, understanding, skills in mathematics, natural sciences, engineering graphics,

standard of higher education specialty)	mathematical modeling of chemical and chemical-technological processes at the level necessary to achieve other results provided by the educational program. PR -2. Ability to apply knowledge and understanding in chemistry to solve the qualitative and quantitative problems of chemical engineering and technology. PR-3. Ability to demonstrate understanding of the broad interdisciplinary context of the specialty. PR -4. Ability to solve complex specialized tasks and practical problems in teaching and professional activity on the basis of critical understanding of knowledge of the basic theories, principles, methods and advanced achievements of chemical engineering and technologies, as well as alternative energy. PR -5. Ability to solve complex unpredictable tasks and problems of chemical engineering and technologies, which involves the collection and interpretation of information (data), the choice of methods and tools, and the application of innovative approaches. PR -6. Ability to assess the impact of technological factors on the composition of the final product. PR -7. Ability to search literature, consult and critically use scientific databases and other relevant sources of information, carry out modeling and analysis for the purpose of detailed study and research of engineering issues in accordance with specialization. PR -8. Ability to correlate the results of experimental studies and mathematical modeling of chemical and chemical-technological processes with corresponding theories. PR -9. Ability to investigate the influence of physical and chemical factors on the properties of the object of research or design. PR -10. Ability to carry out qualitative and quantitative analysis of substances of inorganic and organic origin, using appropriate methods of general and inorganic, organic, analytical, physical and colloidal chemistry. PR -11. Ability to use modern information and communication technologies to solve problems of chemical engineering and technologies, as well as alternative energy sources. PR -12. Ability to carry out the feasibility study of chemical production, to have methods of improving the technological process, to understand the theoretical and practical approaches to the creation and
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	management of production. PR -13. Ability to carry out and substantiate the choice of technological equipment, use automated design systems for the development of technological and hardware schemes of chemical and technological industries, in particular, in the field of alternative energy resources. PR -14. Laboratory / technical skills and the ability to design and perform experimental studies and laboratory measurements, interpret the data obtained and draw conclusions in accordance with the educational program. PR -15. Ability to inform specialists and non-professionals about information, ideas, problems, decisions and their own experience in the field of chemical engineering in the state and one of the main European languages. PR -16. Ability to adhere to safety precautions in the workplace. PR -17. Ability to effectively formulate a communication strategy.
Program results of training by specialization (defined by the institution of higher education)	Block 161-01 Chemical Technology of Inorganic Substances
	RTS-1. Know and understand the concepts, principles and theories that belong to the theoretical foundations of inorganic substances technology. RTS -2. Ability to apply knowledge and understanding of physical and chemical properties of raw materials and finished products. RTS -3. Be able to choose and apply methods for processing natural water to meet production needs. RTS -4. Be able to apply methods of analytical and instrumental control of properties and composition of substances and materials. RTS -5. Ability to apply knowledge and understanding of the basics of industrial catalysis. RTS -6. Ability to know and understand the basics of selecting the necessary and sufficient technological stages for obtaining inorganic products. RTS -7. To be able to calculate and apply equipment of inorganic materials technologies. RTS -8. Be able to use knowledge and understanding of mathematical modeling and optimization of chemical and technological processes. RTS -9. Be able to choose and apply automated design methods. RTS -10. Know and be able to use resource-saving technologies.
	Block 161-03 Technical Electrochemistry
	RTS -1. Ability to apply knowledge and understanding of the concepts, principles and theory of theoretical electrochemistry RTS -2. Know and be able to apply modern materials in the technology of electrochemical industries. RTS -3. Know and be able to apply electrochemical systems for energy needs. RTS -4. Know and be able to apply electrochemical systems in methods of chemical analysis.

	RTS -5. Ability to apply concepts, principles and theories for solving technological problems of technical electrochemistry. RTS -6. Ability to demonstrate knowledge and understanding of the concepts, principles and theories related to the chemical resistance of materials and to be able to realize the protection against corrosion. RTS -7. Ability to demonstrate knowledge and understanding of concepts, principles and theories related to the chemical resistance of materials and the protection of materials and equipment against corrosion. RTS -8. Ability to solve problems and problems of design of electrochemical manufactures. RTS -9. Know and understand the methods of automated design. RTS -10. Know and be able to apply electrochemical resource-saving technologies.
	Block 161-04 Chemical technologies of refractory non-metal and silicate materials
	RTS -1. Ability to apply knowledge and understanding of the concepts, principles and theory of refractory non-metallic and silicate materials RTS -2. Know and be able to apply modern materials in refractory non-metallic and silicate materials. RTS -3. Know and be able to apply physico-chemical oxide systems for the needs of production of refractory non-metal and silicate materials. RTS -4. Know and be able to apply thermodynamic methods of analysis to predict the formation of ceramic, refractory, abrasive and glass-crystalline materials. RTS -5. Ability to apply the concepts, principles and theory of physical chemistry of silicates. RTS -6. Know and be able to apply petrographic and physico-chemical analysis methods for ceramic, refractory, abrasive and glass-crystalline materials. RTS -7. Know and be able to choose equipment for the production of refractory non-metal and silicate materials. RTS -8. Ability to solve problems and problems of designing production of refractory non-metal and silicate materials. RTS -9. Know and understand the methods of automated design. RTS -10. Know and be able to apply resource and energy-saving technologies.
	Block 161-06 Chemical processing technology of polymeric and composite materials
	RTS -1. Apply knowledge in chemistry and physics of high molecular weight compounds (IUDs), as well as technology and equipment for the processing of polymers to solve technological problems in the processing of polymeric and composite materials RTS -2. To evaluate the influence of technological factors in the processing of polymeric and composite materials on the quality indicators of the products obtained. RTS -3. Carry out a qualitative and quantitative analysis of monomers and auxiliary substances used in the production and processing of polymeric and composite materials. RTS -4. Use modern information and communication technologies to search, calculate, create graphic and text documents in research and

	design of technological processes for the processing of polymeric and composite materials. RTS -5. To carry out a feasibility study on the processing of polymeric and composite materials, to have methods for improving the technological process, to understand the theoretical and practical approaches to the creation and management of production. RTS -6. To make a choice of the corresponding technological equipment and to graphically depict the process of processing of polymeric and composite materials. RTS -7. Know and understand the methods of automated design.
	Block 161-07 Polymer Technology for the Medical, Pharmaceutical, Food and Life Sciences
	RTS -1. Apply knowledge of chemistry and physics of high molecular weight compounds (IUDs), as well as chemical technology of the Navy to solve technological problems in the production of polymers and elementomers for various industries. RTS -2. To evaluate the influence of technological factors in the production of polymers and elastomers on the quality indicators of the products obtained. RTS -3. To carry out qualitative and quantitative analysis of monomers and auxiliary substances used in the production of polymers and elementomers. RTS -4. Use modern information and communication technologies for searching, calculating, creating graphic and text documents in the research and design of technological processes for the production of polymers and elementomers for various industries. RTS -5. To carry out a feasibility study for the medical, pharmaceutical, food and beverage industries, to have the methods of improving the technological process, to understand the theoretical and practical approaches to the creation and management of production. RTS -6. Choose the appropriate technological equipment and graphically depict the technological process for the production of polymers and elastomers. RTS – 7 Know and understand the production of polymers and elastomers, automated design methods.
	Block 161-08 Technology of paint and varnish materials and polymeric coatings
	RTS -1. Ability to apply knowledge and understanding of theories, concepts and principles of organic chemistry in predicting optimal methods and approaches to the synthesis of polymer film formers and other substances of organic origin. RTS -2. Ability to apply knowledge and understanding about the choice and prediction of the influence of the pigment component on the performance of paint and varnish materials and optimization of their formulations. RTS -3. Ability to apply knowledge and understanding on the theoretical foundations of obtaining macromolecular compounds in order to optimize the technological processes of their production, regulation and forecasting of their properties. RTS -4. The ability to apply chemical analysis methods to determine, control and predict the properties of polymer composite materials, and cover them on the basis.

	RTS -5. Ability to apply knowledge and understanding on the theoretical foundations of obtaining macromolecular compounds in order to optimize the technological processes of their production, regulation and forecasting of their properties. RTS -6. Know the basic approaches to determining the physical properties of polymers and the ability to solve the problems of determining and predicting the physical properties of polymers, depending on their chemical structure, molecular mass and physical state. RTS -7. Ability to apply knowledge and understanding of the regularities of modern technological processes of obtaining polymers for prediction of properties, selection and substantiation of technological parameters of their manufacturing, general optimization of technological processes. RTS -8. Ability to apply knowledge and understanding of the main colloid and chemical properties of polymer disperse systems in the technological processes of their obtaining. RTS -9. Ability to choose and apply equipment for the production of polymers, in particular, film formers in paintwork materials in order to optimize the technological processes of their manufacture. RTS -10. Ability to solve problems and problems of design of paints and varnishes. RTS -11. Ability to apply knowledge and understanding of general theoretical and practical approaches to the choice of prescription components, preparation of recipes, regulation of the properties of artistic and printing inks in the technological processes of their obtaining. RTS -12. Ability to apply knowledge and understanding about forecasting of properties, selection and substantiation of modern approaches to compilation of recipes, ways of optimization of technological processes of manufacturing of modern pigmented paint and varnish materials. RTS -13. Know the basic characteristics of paint and varnish materials and paint surfaces, as well as factors influencing the processes of formation of paint and varnish coatings and their finite properties. RTS -14. Ability to choose and apply equipment for the production of pigmented paint and varnish materials in order to optimize the technological processes of their production. RTS -15 Ability to apply knowledge and understanding of the application of the basic conceptual provisions of biochemistry in the technology of obtaining polymer coatings in order to regulate their special performance properties.
	Block 161-09 Chemical technologies of rare scattered elements and materials on their basis
	RTS -1. Ability to apply knowledge and understanding of the concepts, principles and theory of the theoretical foundations of the chemistry of rare scattered elements. RTS -2. Know and be able to apply modern materials in the chemical technologies of rare scattered elements. RTS -3. Know and be able to apply materials based on rare scattered elements in the power industry. RTS -4. Know and be able to apply analysis methods for materials

	based on rare scattered elements. RTS -5. Ability to apply concepts, principles and theories to solve technological problems of chemical technologies of rare scattered elements and materials on their basis. RTS -6. Ability to demonstrate knowledge and understanding of the concepts, principles and theories related to the chemical resistance of materials and to be able to realize the protection against corrosion. RTS -7. Ability to demonstrate knowledge and understanding of concepts, principles and theories related to the chemical resistance of materials and the protection of materials and equipment against corrosion. RTS -8. Ability to solve problems and problems of design of chemical production of rare scattered elements and materials on their basis. RTS -9. Know and understand the methods of automated design. RTS -10. Know and be able to apply energy-saving technologies of rare scattered elements and materials based on them.
	Block 161-11 Integration of technological processes, energy efficiency software RTS -1. Ability to create project documents using computer graphics techniques, taking into account the requirements of standards. RTS -2. Ability to demonstrate knowledge about the analysis of technological objects in terms of the basic typical processes of chemical technology, using the methods of physical and mathematical modeling, experimental research data, engineering calculation methods. RTS -3. Ability to determine the basic physical parameters of technological processes of objects of the industry for the engineering calculations of operating modes of equipment RTS -4. Ability to determine the physical indicators characterizing the process, using means of measuring and conducting experimental research and analysis of measurement results using modern means of information processing RTS -5. Ability to demonstrate the ability to use the basics of modeling, designing operation, performance control of computer-integrated systems that implement the principles of optimizing energy costs. RTS -6. Ability to form computer models of chemical and technological systems with the help of modern software for optimization of investigated processes in stationary and dynamic conditions. RTS -7. Knowledge of the basic physical laws of the course of chemical and technological processes, systems of differential equations, describing them and methods of their solution using mathematical and computer simulation RTS -8. Ability to analyze the basic typical hydrodynamic, thermal and mass transfer processes in order to determine the operating modes and dimensions of the main equipment RTS -9. Ability to solve tasks of optimizing the use of external energy sources by chemical-technological systems using pinch methods - designing RTS -10. Demonstrate the ability to implement energy efficiency enhancement projects in the modernization of chemical and

	technological systems through the introduction of regenerative heat transfer networks and the use of renewable energy and secondary energy resources
8 - Resource support for the implementation of the program	
Personnel support	It meets the personnel requirements to ensure the implementation of educational activities in the field of higher education in accordance with the current legislation of Ukraine ("Licensing conditions for the extension of educational activities" in the wording of the Resolution of the Cabinet of Ministers of Ukraine dated May 10, 2018, No. 347
Material and technical support	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 ("Licensing conditions for conducting educational activities" in the wording of the Resolution of the Cabinet of Ministers of Ukraine dated May 10, 2018, No. 347
Information and educational and methodological support	It meets the requirements for information and educational and methodological support for the implementation of educational activities in the field of higher education in accordance with the current legislation of Ukraine ("Licensing conditions for conducting educational activities" in the wording of the Resolution of the Cabinet of Ministers of Ukraine dated May 10, 2018, No. 347
9 - Academic mobility	
National Credit Mobility	On the basis of bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and 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.
Teaching foreign applicants for higher education	Conducted in Ukrainian, English, Russian. The university has courses on studying Ukrainian and Russian languages. There is the possibility of continuing education at the second (master's) and third (PhD) levels of higher education. Available: - structural subdivision for work with foreigners and stateless persons, whose functions include, in particular, the issuance of invitations to study and ensuring the stay of foreigners and stateless persons in Ukraine on legal grounds; - residential premises suitable for the residence of foreigners and stateless persons. Training is provided for the following disciplines: - Ukrainian as a foreign language; - language of professional training.

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of Educational Program (discipline)	Quantity of ECTS credits	Form of final control (semester)
1 General training (77 credits)			
GT 1	Ukrainian language	3	Exam (1)
GT 2	Foreign Language	12	Set-off(1,2,7,8)
GT 3	Higher Mathematics Part 1	4	Exam (3)
GT 4	Higher Mathematics Part 2	4	Exam (1)
GT 5	Physics Part 1	4	Exam (2)
GT 6	Physics Part 2	4	Exam (1)
GT 7	General and Inorganic Chemistry Part 1	6	Exam (2)
GT 8	General and inorganic chemistry part 2	6	Exam (1)
GT 9	Organic Chemistry Part 1	5	Exam (2)
GT 10	Organic Chemistry Part 2	4	Exam (2)
GT 11	History and culture of Ukraine	4	Exam (2)
GT 12	Ecology	3	Exam (2)
GT 13	Philosophy	3	Set-off(2)
GT 14	Science of law	3	Exam (4)
GT 15	Physical Education	12	Set-off(3)
2 Professional training (73 credits)			
PT 1	Descriptive geometry, engineering and computer graphics	3	Set-off (1)
PT 2	Introduction to	4	Set-off (1)
PT 3	Physical Chemistry Part 1	6	Exam (3)
PT 4	Physical Chemistry Part 2	4	Exam (4)
PT 5	Processes and apparatuses of chemical manufactures Part 1	6	Exam (3)
PT 6	Processes and Apparatus of Chemical Production Part 2	5	Exam (4)
PT 7	Analytical chemistry	3	Set-off (3)
PT 8	Computational Mathematics and Programming	4	Set-off (3)
PT 9	General chemical technology	5	Exam (5)
PT 10	Surface phenomena and disperse systems (colloidal chemistry)	4	Exam (4)
PT 11	History of science and technology	3	Set-off (5)
PT 12	Mathematical modeling and optimization of objects of chemical technology	4	Exam (5)
PT 13	Control and management of chemical and technological processes	4	Set-off (6)
PT 14	Business Economics	3	Set-off (7)
PT 15	Fundamentals of occupational safety and health	3	Exam (6)
PT 16	Practice	6	Exam (8)
PT 17	Attestation	6	DP / DW defense
3 Disciplines of free choice by blocks (90 credits)			
Block of disciplines 161-01 Chemical technologies of inorganic substances			
FC 1.1	Applied Chemistry	3	Set-off (4)
FC 1.2	Computer design of inorganic substances production	4	Exam (4)
FC 1.3	Theoretical foundations of the technology of inorganic substances	5	Exam (5)

FC 1.4	Catalysis in chemistry and chemical technology	4	Set-off (5)
FC 1.5	Construction materials and transport equipment in inorganic manufactures p.1	3	Set-off (4)
FC 1.6	Chemical technologies of carbon-containing substances	5	Exam (5)
FC 1.7	Resource and energy-saving technologies in the production of inorganic products	5	Exam (6)
FC 1.8	Catalytic reactors and heat and mass transfer in the production of inorganic synthesis	6	Exam (6)
FC 1.9	Construction materials and transport equipment in inorganic manufactures. Part 2	5	Exam (6)
FC 1.10	Special methods of analysis in the technology of inorganic substances	4	Set-off (6)
FC 1.12	Equipment industry	6	Exam (7)
FC 1.13	Drinking water technologies and water treatment in inorganic substances production	4	Set-off (7)
FC 1.14	Nitrogen-bound technologies	4	Exam (7)
FC 1.15	Mineral acids technology	4	Exam (7)
FC 1.16	Technologies of mineral fertilizers and salts	4	Exam (8)
FC 1.17	Soda, alkali and alumina technologies	4	Exam (8)
FC 1.18	Fundamentals of Nanotechnology and Research	4	Exam (8)
Block of disciplines 161-03 Technical electrochemistry			
FC 3.1	Theoretical electrochemistry ch.1	7	Exam (4)
FC 3.2	Theoretical electrochemistry Part 2	5	Exam (5)
FC 3.3	Materials science	3	Set-off (5)
FC 3.4	Electrochemical power engineering	3	Set-off (5)
FC 3.5	Electrochemical methods of analysis	4	Exam (5)
FC 3.6	Technical electrochemistry Part 1	7	Exam (6)
FC 3.7	Hydroelectrometallurgy	5	Exam (6)
FC 3.8	Galvanoplasty and decorative metal processing	4	Set-off (6)
FC 3.9	Corrosion of metals	4	Exam (6)
FC 3.10	Technical Electrochemistry Part 2	7	Exam (7)
FC 3.11	Equipment of electrochemical manufactures Part 1	4	Set-off (7)
FC 3.12	Systems of automated designing Part 1	3	Set-off (7)
FC 3.13	Methods of protection against corrosion	4	Exam (7)
FC 3.14	Equipment of electrochemical manufactures p.2	5	Exam (8)
FC 3.15	Systems of automated designing Part 2	4	Exam (8)
FC 3.16	Design of electrochemical manufactures	4	Exam (8)
FC 3.17	Resource-saving electrochemical production	3	Exam (8)
Block of disciplines 161-04 Chemical technologies of refractory non-metal and silicate materials			
FC 4.1	Fundamentals of refractory technology	3	Set-off (4)
FC 4.2	Fundamentals of technology of ceramic materials	4	Exam (4)
FC 4.3	Basics of glass and enamel technology	4	Set-off (5)
FC 4.4	Fundamentals of technology of weaving materials	4	Exam (5)
FC 4.5	Thermal processes in the technology of refractory non-metal and silicate materials	5	Exam (5)
FC 4.6	Crystallography and mineralogy p.1	4	Set-off (5)
FC 4.7	Crystallography and mineralogy Part 2	4	Exam (6)
FC 4.8	Physico-chemical bases of the structure of one-component systems	5	Set-off (6)

FC 4.9	Physico-chemical basis of the structure of two-component systems	5	Exam (6)
FC 4.10	Physico-chemical bases of the structure of three-component systems	6	Exam (7)
FC 4.11	Mechanical equipment of enterprises	3	Exam (6)
FC 4.12	Resource and energy saving in the technology of refractory non-metallic and silicate materials	6	Exam (7)
FC 4.13	Petrographic methods of analysis	3	Exam (7)
FC 4.14	Physico-chemical methods of analysis	3	Exam (7)
FC 4.15	Production of ceramics and refractories	4	Exam (8)
FC 4.16	Manufacture of glass, enamels, protective coatings	4	Set-off (8)
FC 4.17	Production of astringent materials	4	Set-off (8)
FC 4.18	Information technology of refractory non-metal and silicate materials	4	Exam (8)
FC 4.19	Heat engineering equipment of enterprises	3	Exam (6)
Block of disciplines 161-06 Chemical technology of processing of polymeric and composite materials			
FC 6.1	Chemistry and technology of monomers for polymerization plastics	4,0	Exam (4)
FC 6.2	Chemistry and technology of monomers for polycondensation plastics	3	Set-off (4)
FC 6.3	Chemistry and physics of macromolecular compounds Part 1	6,0	Exam (5)
FC 6.4	Chemistry and physics of macromolecular compounds, Part 2	6,0	Exam (6)
FC 6.5	Theoretical basis for polymer processing	4,0	Exam (5)
FC 6.6	Nanotechnology and Resource Saving in the Industry	3,0	Set-off (5)
FC 6.7	Basis of creation of polymer mixtures and composites	4,0	Exam (5)
FC 6.8	Polymeric materials science	6,0	Exam (6)
FC 6.9	Information technology in the industry	4,0	Set-off (6)
FC 6.10	Chemical reactions on polymeric carriers	4,0	Exam (6)
FC 6.11	Technology and equipment for polymer processing	6,0	Exam (7)
FC 6.12	Chemistry of biopolymers	5,0	Exam (7)
FC 6.13	Fundamentals of Chemical Production Design	3,0	Exam (7)
FC 6.14	Modern adhesives and sealants	4,0	Exam (7)
FC 6.15	Rheology and strength of polymers	6,0	Exam (8)
FC 6.16	Certification, accreditation and quality management of products	4,0	Exam (8)
FC 6.17	Fundamentals of chemistry and technology of biodegradable polymers	3,0	Exam (8)
FC 6.18	Reception of products for the food industry and everyday life	3,0	Exam (8)
Block of disciplines 161-07 Technology of polymers for the medical, pharmaceutical, food industries and everyday life			
FC 7.1	Chemistry and technology of monomers for polymerization plastics	4,0	Exam (4)
FC 7.2	Chemistry and technology of monomers for polycondensation plastics	3	Set-off (4)
FC 7.3	Chemistry and physics of macromolecular compounds Part 1	6,0	Exam (5)
FC 7.4	Chemistry and physics of macromolecular compounds,	6,0	Exam (6)

	Part 2		
FC 7.5	Modern equipment for the production of plastics	4,0	Exam (5)
FC 7.6	Nanotechnology and Resource Saving in the Industry	3,0	Set-off (5)
FC 7.7	Basis of creation of polymer mixtures and composites	4,0	Exam (5)
FC 7.8	Technology of production of high molecular compounds p.1	6,0	Exam (6)
FC 7.9	Information technology in the industry	4,0	Set-off (6)
FC 7.10	Chemical reactions on polymeric carriers	4,0	Exam (6)
FC 7.11	Technology of production of high-molecular compounds p.2	6,0	Exam (7)
FC 7.12	Chemistry of biopolymers	5,0	Exam (7)
FC 7.13	Fundamentals of Chemical Production Design	3,0	Exam (7)
FC 7.14	Polymers for modern medicine and pharmacy	4,0	Exam (7)
FC 7.15	Rheology and strength of polymers	6,0	Exam (8)
FC 7.16	Certification, accreditation and quality management of products	4,0	Exam (8)
FC 7.17	Fundamentals of chemistry and technology of biodegradable polymers	3,0	Exam (8)
FC 7.18	Polymer technology for the food industry and everyday life	3,0	Exam (8)
Block of disciplines 161-08 Technology of paint and varnish materials and polymeric coatings			
FC 8.1	Selected chapters of organic chemistry	4	Exam (4)
FC 8.2	The logic of organic synthesis	3	Set-off (4)
FC 8.3	Physical chemistry of pigments	5	Exam (5)
FC 8.4	Fundamentals of polymer chemistry	5	Exam (5)
FC 8.5	Instrumental methods of chemical analysis	3	Set-off (5)
FC 8.6	Polymers based on vegetable oils	4	Set-off (5)
FC 8.7	Fundamentals of physics of polymers	6	Exam (6)
FC 8.8	Basics of polymer technology	6	Exam (6)
FC 8.9	Colloidal chemistry of polymer disperse systems	4	Set-off (6)
FC 8.10	Fundamentals of colorimetry	4	Set-off (6)
FC 8.11	Chemistry and technology of film-forming	6	Exam (7)
FC 8.12	Equipment for the production of film-forming	5	Exam (7)
FC 8.13	Fundamentals of design of paint and varnish enterprises	3	Set-off (7)
FC 8.14	Artistic and printing inks	4	Set-off (7)
FC 8.15	Fundamentals of physical chemistry and technology of pigmented paint and varnish materials	5	Exam (8)
FC 8.16	Physical chemistry of forming polymeric coatings	5	Exam (8)
FC 8.17	Equipment for the production of pigmented paint and varnish materials	3	Exam (8)
FC 8.18	Basics of biochemistry in the technology of obtaining polymeric coatings	3	Exam (8)
Block of disciplines 161-09 Chemical technologies of rare scattered elements and materials on their basis			
FC 9.1	Theoretical foundations of chemistry of rare scattered elements, p.1	7	Exam (4)
FC 9.2	Theoretical foundations of chemistry of rare scattered elements, Part 2	5	Exam (5)
FC 9.3	Materials science	3	Set-off (5)
FC 9.4	Rare scattered elements in energy technologies	3	Set-off (5)

FC 9.5	Methods of analysis in the technology of rare scattered elements	4	Exam (5)
FC 9.6	Chemical technologies of rare scattered elements and materials on their basis ch.1	7	Exam (6)
FC 9.7	Electrochemical technologies of rare scattered metals	5	Exam (6)
FC 9.8	Materials based on noble metals	4	Set-off (6)
FC 9.9	Corrosion of metials	4	Exam (6)
FC 9.10	Chemical technologies of rare scattered elements and materials on their basis Part 2	7	Exam (7)
FC 9.11	Equipment for the production of rare scattered elements and materials based on them ch.1	4	Set-off (7)
FC 9.12	Systems of automated designing Part 1	3	Set-off (7)
FC 9.13	Methods of protection against corrosion	4	Exam (7)
FC 9.14	Equipment for the production of rare scattered elements and materials based on them. Part 2	5	Exam (8)
FC 9.15	Systems of automated designing Part 2	4	Exam (8)
FC 9.16	Designing of rare scattered elements and materials based on them	4	Exam (8)
FC 9.17	Energy-saving technologies of rare scattered elements and materials on their basis	3	Exam (8)
Block of disciplines 161-11 Integration of technological processes, energy efficiency software			
FC 11.1	Special sections of hydro-gas dynamics	3	Exam (4)
FC 11.2	Information technology and programming	4	Exam (4)
FC 11.3	Thermodynamics and heat engineering	4	Exam (5)
FC 11.4	Computer Technology	4	Exam (5)
FC 11.5	Fundamentals of designing equipment for chemical production	5	Exam (5)
FC 11.6	Basics of energy-efficient technologies in industry	4	Exam (5)
FC 11.7	Typical technologies of chemical production	6	Exam (6)
FC 11.8	Fundamentals of measurement and diagnostics in technological systems	5	Exam (6)
FC 11.9	Information systems and complexes	5	Exam (6)
FC 11.10	Unconventional and renewable energy sources	4	Set-off (6)
FC 11.11	Identification and simulation of technological objects	5	Exam (7)
FC 11.12	Fundamentals of integration of chemical and technological processes	5	Exam (7)
FC 11.13	Methods of optimization in chemical technology	4	Exam (7)
FC 11.14	Basics of energy and resource conservation	4	Exam (7)
FC 11.15	Technical and economic bases of analysis and designing of energy-efficient productions	4	Exam (8)
FC 11.16	Special sections of heat and mass transfer	3	Set-off (8)
FC 11.17	Basics of energy management	3	Set-off (8)
FC 11.18	Computer-integrated technologies	3	Exam (8)
FC 11.19	Technical means for processing textual and graphic information	3	Exam (8)
GENERAL VOLUME OF THE EDUCATIONAL PROGRAM - 240 CREDITS			

3. STRUCTURAL-LOGICAL SCHEME OF EDUCATIONAL PROFESSIONAL PROGRAM "CHEMICAL TECHNOLOGY AND ENGINEERING"

4. FORM OF EXPRESSION APPROVAL OF HIGHER EDUCATION BUILDERS

The certification is carried out in the form of public defense (demonstration) of qualifying (diploma) work (project). According to the positive results of the protection of the higher education student, a document (diploma) of the established sample on awarding a bachelor's degree with the qualification: "bachelor of chemical technologies and engineering" on the specialty "technical electrochemicals" is issued.

5. MATRIX OF COMPATIBILITY OF COMPONENTS OF THE EDUCATIONAL SOFTWARE SOFTWARE COMPETENCY

	3K-1	3K-2	3K-3	3K-4	3K-5	3K-6	3K-7	3K-8	3K-9	3K-10	3K-11	3K-12	CK-1	CK-2	CK-3	CK-4	CK-5	CK-6	CK-7	CK-8	CK-9	CK-10	CK-11	OK-1	OK-2	OK-3	OK-4	OK-5	OK-6	OK-7	OK-8	OK-9	OK-10
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