

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE  
"IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE"**

APPROVED

by Academic Council of  
Igor Sikorsky Kyiv Polytechnic Institute

(protocol № \_\_\_\_ dated «\_\_\_\_» \_\_\_\_\_ 20\_\_ p.)

Head of the Academic Council

\_\_\_\_\_ Mykhailo  
ILCHENKO

**INDUSTRIAL ECOLOGY AND RESOURCE  
EFFICIENT CLEANER TECHNOLOGIES**

**EDUCATIONAL AND PROFESSIONAL PROGRAM**

**second (Master's) level of higher education**

<b>Program Subject Area</b>	<b>161 Chemical Technology and Engineering</b>
<b>Field of Study</b>	<b>16 Chemical and Bioengineering</b>
<b>Qualification</b>	<b>Master of Chemical Technology and Engineering</b>

Came into force in 2022/2023 study year  
by the Order of Rector  
of Igor Sikorsky Kyiv Polytechnic Institute  
dated \_\_\_\_\_ 20\_\_ № \_\_\_\_\_

Kyiv – 2022

## PREAMBLE

**DEVELOPED** by the project team:

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## ПОГОДЖЕНО:

Scientific and Methodological Council of Igor Sikorsky Kyiv Polytechnic Institute for program subject area 161 Chemical Technology and Engineering

Head of the SMC 161

\_\_\_\_\_ Olga LINYUCHEVA

(protocol № 3 dated « 22 » 11 2021)

Methodological Council of Igor Sikorsky Kyiv Polytechnic Institute

Head of the Methodological Council

\_\_\_\_\_ Yuriy YAKYMENKO

(protocol №     dated «     »            20    )

## CONSIDERED:

According to the results of the review and public discussion of the OP, after receiving all the wishes and proposals of stakeholders (<https://eco-paper.kpi.ua/navchannia/osvitni-prohramy.html>), the educational and professional program was discussed at a meeting of the department of plant ecology and technology polymers (protocol No. 5 dated November 17, 2021). The results of the discussion in the form of an extract from the department meeting were sent to NMCU 161 Chemical technologies and engineering

In accordance with Order No. HOH/248/2021 dated 22.10.21 "On updating KPI educational programs", the distribution of educational program components by training credits has been changed in the program. The list of educational components was detailed.

According to the results of the review and public discussion of the EP, after receiving all the suggestions and proposals of stakeholders (<https://eco-paper.kpi.ua/navchannia/osvitni-prohramy.html>), the educational and professional program was discussed at the meeting of the Department of Ecology and Plant Polymers Technology (protocol № 5 dated 17.11.2021). The results of the discussion in the form of an extract from the department meeting were forwarded to NMCU 161 Chemical Technology and Engineering.

In accordance with the Order № HOH/248/2021 dated 22.10.21 «About updating of educational programs of KPI» the distribution of educational program components by training credits in the program was changed. The list of educational components was detailed.

## CONTENT

1. PROFILE OF THE EDUCATIONAL PROGRAM .....	4
2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM.....	9
3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM .....	10
4. FORM OF FINAL EXAMINATION OF HIGHER EDUCATION APPLICANTS.....	10
5. MATRIX OF CORRESPONDENCE OF PROGRAM COMPETENCIES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM.....	11
6. MATRIX OF PROVIDING OF PROGRAM LEARNING OUTCOMES BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM .....	11

## 1. PROFILE OF THE EDUCATIONAL PROGRAM

<b>1 – General information</b>	
Full name of HEI and institute / faculty	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Faculty of Chemical Engineering
Higher education level and title of qualification in the original language	HE Degree – Master Educational qualification – Master of Chemical Technology and Engineering
The official name of the educational program	Industrial ecology and resource efficient cleaner technologies
Type of diploma and scope of educational program	Master's diploma, single, 90 ECTS credits, training period 1 year and 4 months
Availability of accreditation	Certificate of accreditation of the Program Subject Area 161, НД № 1192638, in accordance with the decision of the Accreditation Commission dated 30.05.2013, protocol №104 Order of the Ministry of Education and Science of Ukraine dated 04.06.2013 №2070-Л, valid until July 01, 2023
Cycle / level of HE	NFQ of Ukraine - level 7 QF-EHEA - the second cycle EQF-LLL - level 7
Prerequisites	Bachelor's Degree
Language (s) of instruction	Ukrainian
Term of the educational program	Until the next accreditation
Internet address of the permanent placement of the educational program	<a href="https://eco-paper.kpi.ua/">https://eco-paper.kpi.ua/</a> , section "Educational programs" <a href="https://osvita.kpi.ua/">https://osvita.kpi.ua/</a> section "Educational programs"
<b>2 – The goal of the educational program</b>	
<p>Training of specialists in the field of chemical technology and engineering, capable of solving complicated, including innovative, specialized complex tasks of developing new and improving existing chemical technologies and equipment, carrying out organizational activities, conducting research, the results of which have scientific novelty, theoretical and practical significance; and, through a harmonious combination of fundamental knowledge and engineering tools with training in the technical field, to successfully compete on the labor market in conditions of sustainable innovative scientific and technical development of society.</p> <p>Corresponds to the development strategy of Igor Sikorsky Kyiv Polytechnic Institute for 2020-2025 (<a href="https://data.kpi.ua/sites/default/files/files/2020-2025-strategy.pdf">https://data.kpi.ua/sites/default/files/files/2020-2025-strategy.pdf</a>).</p>	
<b>3 – Characteristics of the educational program</b>	
Subject area	<i>Learning and activity objectives:</i> technological processes and equipment of modern chemical industries.

	<p><i>Learning goals</i> – training of specialists capable of solving complex tasks and problems of chemical technologies and engineering that involves research and/or innovation activities and is characterized by uncertainty of conditions and requirements.</p> <p><i>Theoretical content of the subject area</i> – concepts, categories, principles of chemical technologies, processes and equipment of chemical production.</p> <p><i>Methods, techniques and technologies</i>: technologies of chemical industry, physical-chemical research methods, methods of modeling, optimization, decision-making and design of chemical processes and apparatus, methods of planning and processing the results of experiments, methods and technologies of organizational and technological support and economic analysis of chemical production, teaching methods in higher education.</p> <p><i>Tools and equipment</i>: devices and instruments for the analysis of raw materials, intermediate and target products, control and measuring equipment, modern digital technologies, specialized technological and scientific equipment, specialized software.</p>
Orientation of the EP	Educational and Professional. The emphasis on the development of new and improvement of existing technological processes and equipment of chemical production, aimed at the maximum conservation of all production resources and minimizing the negative impact on the environment.
The main focus of the EP	<p>Special education in the field of technical sciences, Program Subject Area 161 Chemical Technology and Engineering.</p> <p>Key words: chemical technologies, technological processes, resource saving, environment, sustainable development, natural resources, environmental protection, cleaner technologies.</p> <p>The program is based on well-known scientific provisions in the field of chemical technologies and engineering, taking into account the current state of technology and equipment development; focuses on up-to-date scientific problems, within which further professional and scientific growth of researchers in the field of rational use of natural resources, management of technological processes of chemical production, development of promising resource-saving production technologies with minimal negative impact on the environment is possible.</p>
Features of the EP	<p>Interdisciplinary and multidisciplinary training of specialists in chemical technologies and engineering.</p> <p>The program provides for pre-diploma practice at companies and specialized scientific institutions; participation of applicants for higher education in student scientific circles; the possibility of teaching individual special courses in a foreign language, international activities in the field of mobility and internships for students and teachers.</p>
<b>4 – Qualification of graduates for employment and further studying</b>	
Qualification for employment	<p>Graduates can carry out professional activities according to the type of economic activity "Research and experimental development in natural sciences and engineering" (NACE code 72.10, ISIC code 731), "Technical testing and research" (NACE code 71.20), "Activity in the field of engineering, geology and geodesy, technical consulting service in these areas" (NACE code 71.12), "Manufacturing of paper and paper products" (NACE section 17). Graduates can provide services related to scientific research and experimental development in the field</p>

	<p>of technical sciences, as well as scientific, technical, consulting services related to environmental protection, industrial product design (DK code 016:2010: 72.19.29, 72.19.21, 72.19.50, 74.10.12, 74.90.13, 74.90.19). Graduates can work in primary positions in the professions defined by the National Classification of Ukraine: Classifier of professions DK 003:2010</p> <p>2146.2 Chemical engineers:  Technological engineer (chemical technologies)  Engineer (chemical technology)  Water treatment technologist</p> <p>2149.2 Engineers (other branches of engineering)  2149.2 Environmental Protection Engineer  2211.2 Environmental Specialist</p>
Further training	<p>Study at the Doctor of Philosophy program at the third educational and scientific level of higher education.</p> <p>Acquisition of additional qualifications in the postgraduate education system.</p>
<b>5 – Teaching and evaluation</b>	
Teaching and learning	<p>Student-centered learning through lectures, seminars, practical classes; personal differentiated and problem-oriented learning through laboratory and scientific and research practice, self-study through consultations with a teacher, individual classes.</p>
Evaluation	<p>Current and semester control is carried out in accordance with the Rating system of evaluation of the results of laboratory work, practical tasks, control works, reports, presentations, tests and exams; defenses of course projects, term papers, Master's thesis.</p>
<b>6 – Program competencies</b>	
Integral competence	<p>The ability to solve complex tasks and problems in the field of ecology, environmental protection and balanced nature management and on the border of subject areas, and in the learning process, which involves conducting research and/or implementing innovations and is characterized by the complexity and uncertainty of conditions and requirements.</p>
<b>General competences</b>	
C1	The ability to generate new ideas (creativity)
C2	The ability to apply knowledge in practical situations
C3	The ability to search, process and analyze information from various sources
<b>Special (professional) competences</b>	
C4	The ability to research, classify and analyze quality indicators of chemical products, technological processes and equipment of chemical production.
C5	The ability to organize and manage chemical-technological processes in the conditions of industrial production and in research laboratories, taking into account social, economic and environmental aspects.
C6	The ability to use the results of scientific investigations and research and development works for the improvement of existing and/or the development of new technologies and equipment of chemical industries.
C7	The ability to use up-to-date special scientific equipment and software when making experimental research and conducting research and development in the field of chemical technologies and engineering.
C8	The ability to independently develop technological projects through creative application of existing and generation of new ideas.
C9	The ability to demonstrate knowledge and own conclusions to specialists and non-specialists.

C10	The ability to develop and manage projects.
C11	The ability to apply new approaches to the analysis and forecasting of complex phenomena, critical understanding of problems in professional activity.
C12	The ability to communicate in a foreign language in professional activities.
C13	The ability to manage the strategic development of the team in the professional activities.
C14	The ability to organize work related to the assessment of the ecological state, environmental protection and optimization of nature management.
<b>7 – Program learning outcomes</b>	
PO1	To critically interpret scientific concepts and modern theories of chemical processes and chemical engineering, apply them when making scientific research and creating innovations
PO2	To search for the necessary information on chemical technology, processes and equipment for the production of chemicals and materials based on them, to systematize, analyze and evaluate the relevant information
PO3	To organize own work and the team work in the conditions of industrial production, project divisions, research laboratories, to determine goals and effective ways to achieve them, to motivate and train personnel
PO4	To evaluate the technical and economic characteristics of the results of scientific research, experimental development, technologies and equipment of chemical production
PO5	To communicate fluently in national and foreign languages orally and in writing to discuss and present the results of professional activities, research and projects
PO6	To develop and implement projects in the field of chemical technologies and related interdisciplinary projects taking into account social, economic, environmental and legal aspects
PO7	To search for the necessary information in scientific and technical literature, patents, databases, and other sources on chemical technology, processes and equipment for the production of chemical substances and materials based on them, to systematize, analyze and evaluate the relevant information
PO8	To be able to independently make and justify strategic decisions in the field of chemical technologies and engineering
PO9	To be able to clearly and unambiguously convey professional knowledge, own justifications and conclusions to specialists and the general public, to present own and collective technological projects, including innovative projects
PO10	To demonstrate awareness of the latest principles and methods of environmental protection
PO11	To be able to use up-to-date information technologies
PO12	To know modern approaches to the organization of environmentally friendly productions, reorganization and reconstruction of existing productions from the standpoint of resource conservation
<b>8 – Resource support for program implementation</b>	
Staffing	In accordance with the staffing requirements to support educational activities for the respective HE level, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current edition: Involvement of professional practitioners and lecturers from other higher education institutions in teaching professional-oriented disciplines. Staffing complies with applicable license requirements.

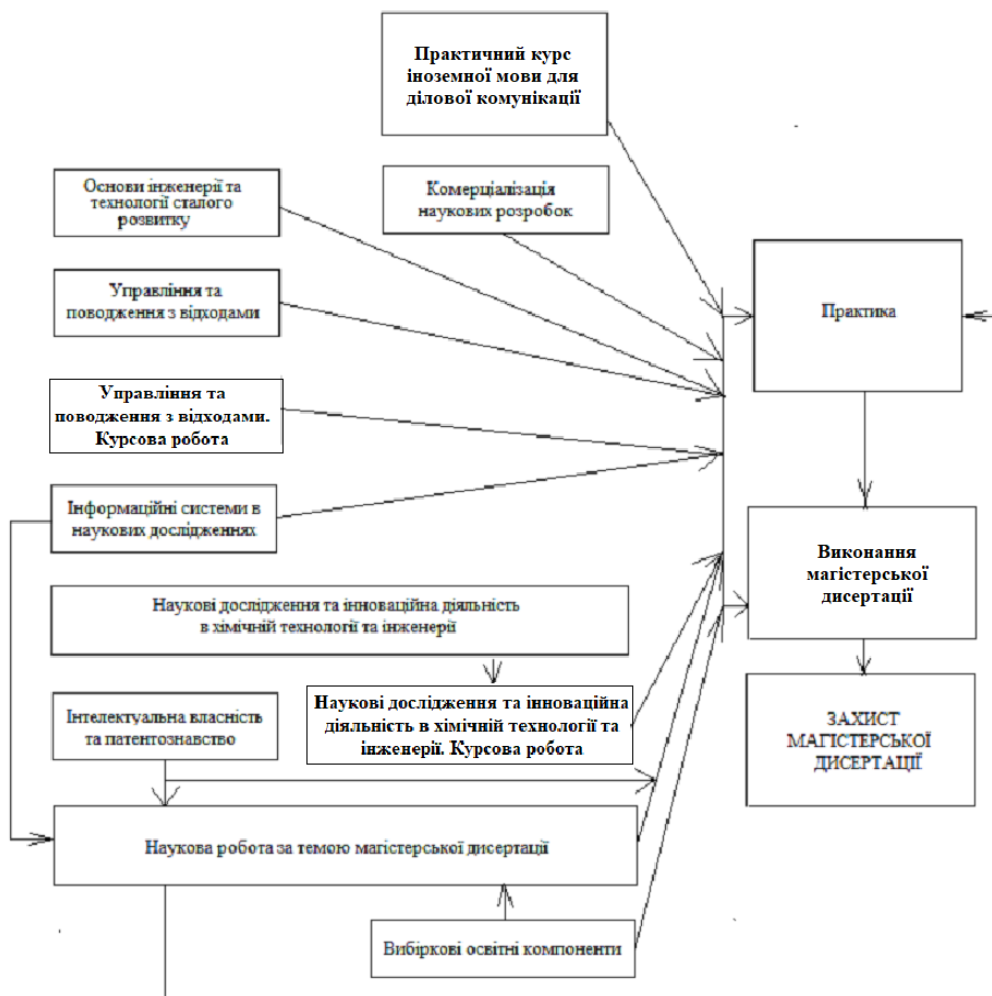
Material-technical support	<p>In accordance with the technological requirements for material-technical support of educational activities of the respective HE level, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current edition:</p> <p>A specialized laboratory, a complex of laboratories of the department and the auditorium, equipped with technical means of demonstration, including multimedia systems, are available for research.</p> <p>There are scientific and educational complexes "Environmentally friendly technologies for humans" and "Surface chemistry and physics" of Igor Sikorsky Kyiv Polytechnic Institute and the Department of Chemistry of the National Academy of Sciences of Ukraine, on the basis of which students gain experience in solving environmental problems. There is an option of remote information exchange and interaction with teachers.</p> <p>Meets license requirements.</p>
Information and educational-methodical support	<p>In accordance with the technological requirements for training-methodological and informational support of education activities of the respective HE level, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current edition:</p> <p>The use of the library at the department and the Scientific and Technical Library of Igor Sikorsky Kyiv Polytechnic Institute.</p>
<b>9 – Academic mobility</b>	
National credit mobility	Possibility of making agreements on academic mobility in accordance with the current legislation of Ukraine in the field of the higher education.
International credit mobility	Erasmus+KA1 academic mobility program, participation in the university's academic mobility programs on a competitive basis.
Training of foreign HE applicants	Possibility of education in English in separate academic groups, while Ukrainian is studied as a foreign language; or in Ukrainian in joint groups with Ukrainian applicants.



## 2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of the educational program (disciplines, course projects (works), practice, qualifying work)	ECTS Credits	Final examination
<b>1. COMPULSORY educational components</b>			
<b>1.1. General training cycle</b>			
GC 01.1	Intellectual Property and Patenting. Part 1. Intellectual Property	1	final test
GC 01.2	Intellectual Property and Patenting. Part 2. Patenting and Acquisition of Rights	2	final test
GC 02	Fundamentals of Engineering and Technology of Sustainable Development	2	final test
GC 03	Practical Course in Foreign Language for Business Communication	3	final test
GC 04	Commercialization of Scientific Developments	3	final test
<b>1.2. Vocational training cycle</b>			
VC 01	Waste Management	6	exam
VC 02	Coursework in Waste Management	1	final test
VC 03	Information Systems in Scientific Research	4	exam
VC 04.1	Scientific Research and Innovative Activity in Chemical Technology and Engineering. Part 1. Analysis of Current Problems of Chemical Technologies and Engineering	10,5	exam
VC 04.2	Scientific Research and Innovative Activity in Chemical Technology and Engineering. Part 2. Theoretical and Experimental Solution of Scientific Tasks in Chemical Technology and Engineering	3,5	final test
VC 05	Coursework in Scientific Research and Innovative Activity in Chemical Technology and Engineering	1	final test
<b>Research (scientific) component</b>			
VC 06.1	Scientific Work on the Topic of Master's Thesis. Part 1. Fundamentals of Scientific Research	2	final test
VC 06.2	Scientific Work on the Topic of Master's Thesis. Part 2. Scientific and Research Work on the Topic of Master's Thesis	2	final test
VC 07	Practice	14	final test
VC 08	Master's Thesis	12	defense
<b>2. OPTIONAL educational components</b>			
<b>Vocational training cycle</b>			
VO 01	Educational component 1 F-Catalog	5	exam
VO 02	Educational component 2 F-Catalog	5	exam
VO 03	Educational component 3 F-Catalog	5	exam
VO 04	Educational component 4 F-Catalog	4	final test
VO 05	Educational component 5 F-Catalog	4	final test
<b>Total in compulsory components:</b>		<b>67</b>	
<b>Total in optional components:</b>		<b>23</b>	
<b>Total in educational components that ensure the acquisition of competencies defined by the SHE</b>		<b>45</b>	
<b>TOTAL in EDUCATIONAL PROGRAM</b>		<b>90</b>	

### 3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



### 4. FORM OF FINAL EXAMINATION OF HIGHER EDUCATION APPLICANTS

Forms of final examination of higher education applicants	Attestation is carried out in the form of public defense of qualifying work.
<b>Requirements to qualifying work</b>	<p>The qualifying work should involve solving a complex task or problem in the field of chemical technologies and engineering, which involves research and/or innovation and is characterized by uncertainty of conditions and requirements.</p> <p>The main results of the qualifying work must be approved, published and checked for plagiarism.</p> <p>The defense of the qualifying work is completed with the issuance of a document of the established form on awarding the graduate a Master's degree with the qualification: Master of Chemical Technology and Engineering.</p> <p>The qualifying work must be posted on the website of the higher education institution or its structural subdivision <a href="https://eco-paper.kpi.ua/">https://eco-paper.kpi.ua/</a> (abstract), or in the repository of the higher education institution (Electronic Archive of Scientific and Educational Materials of</p>

## 5. MATRIX OF CORRESPONDENCE OF PROGRAM COMPETENCIES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM

	GC 01.1	GC 01.2	GC 02	GC 03	GC 04	VC 01	VC 02	VC 03	VC 04.1	VC 04.2	VC 05	VC 06.1	VC 06.2	VC 07	VC 08
C1	+	+			+				+	+	+	+	+	+	+
C2	+	+	+	+	+		+		+	+	+	+	+	+	+
C3	+	+				+		+	+	+	+	+	+	+	+
C4					+			+				+	+		+
C5					+							+	+	+	
C6								+	+	+	+	+	+		+
C7									+	+	+	+	+	+	+
C8														+	+
C9														+	+
C10					+									+	+
C11			+			+								+	+
C12				+											
C13					+										
C14						+	+							+	+

## 6. MATRIX OF PROVIDING OF PROGRAM LEARNING OUTCOMES BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	GC 01.1	GC 01.2	GC 02	GC 03	GC 04	VC 01	VC 02	VC 03	VC 04.1	VC 04.2	VC 05	VC 06.1	VC 06.2	VC 07	VC 08
PO 1									+	+	+	+	+	+	+
PO 2	+	+						+				+	+	+	+
PO 3			+		+							+	+	+	+
PO 4									+	+	+	+	+		+
PO 5	+	+	+	+					+	+	+	+	+	+	+
PO 6			+		+				+	+	+				+
PO 7	+	+						+	+	+	+				
PO 8														+	+
PO 9														+	+
PO 10						+	+							+	+
PO 11								+						+	+
PO 12														+	+