



EDUCATIONAL PROGRAM

Educational Program Group:	B072 "Pharmaceutical production technology"
The code of the educational program:	6B07205
Name of the educational program:	"Digital engineering in pharmaceuticals and medicine"
The level of the educational program:	Bachelor's Degree

Shymkent, 2025

ОҢТҮСТІК ҚАЗАҚСТАН MEDISINA AKADEMIASY «Оңтүстік Қазақстан медицина академиясы» АҚ	 SOUTH KAZAKHSTAN MEDICAL ACADEMY АО «Южно-Казakhstanская медицинская академия»
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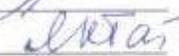
The educational program 6B07270 "Digital Engineering in pharmaceuticals and medicine" was developed by the members of the Joint-Stock Company OP "Technology of Pharmaceutical Production":

Chairman of the AC of EP "Pharmaceutical Production Technology"
 Protocol № 6 dated 24.02 2025

 Torlanova B.O.

Agreed with the departments:

"Medical Biophysics and Information Technology Technologies"
 "Phthisiopulmonology and radiology"
 Protocol № 7 dated 27.02 2025

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 Kasaeva L.T.

Agreed with employers:

Director of «Phyto-Apipharm» LLP
 Director of «Zerde-Phyto» LLP
 Director of «Yuzhkazmedtekhnikan» LLP
 The first head of the State Enterprise for PCV
 «City Diagnostic Center» of the Shymkent City Health Department

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Approved by the Methodological Council

Vice-Rector for academic work
 Protocol № 8 dated 31.03 2025

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Approved by the Academic Council
 Protocol № 11 dated 31.05 2025



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PASSPORT OF THE EDUCATIONAL PROGRAM

1. **The mission of the educational program** is to be recognized as a leader in the field of training competitive personnel, taking into account the interests of the University, its employees and students.
2. **The purpose of the educational program** is to train highly sought-after specialists in the field of design, maintenance and repair of pharmaceutical and medical equipment
3. **Justification of the educational program:** Based on the integration of education and science, create an effective training system for specialists capable of effectively solving managerial tasks related to the maintenance and repair of pharmaceutical and medical equipment.
4. **The professional standard on the basis of which the educational program was developed:**
Normative documents for the development of educational program
 - Code of the Republic of Kazakhstan dated 07.07.2020 № 360- VI "On People's Health and Health Care System" (with amendments and additions as of 04.07.2022);
 - Law of the Republic of Kazakhstan "On Education" dated 27.07.2007 № 319- III with amendments as of 04.07.2022
 - Order of the Minister of Health of the Republic of Kazakhstan "On approval of the state mandatory standards for levels of education in the field of health care" of 04.07.2022, № KRDSM-63 with amendments and additions of 26.06.2025, № 61)
 - Order of the Minister of Science and Higher Education of the Republic of Kazakhstan "On approval of the state mandatory standards of higher and postgraduate education" of 20.07.2022, № 2 with amendments and additions of 04.03.2025, № 90
 - Order of the Minister of Health of the Republic of Kazakhstan "On approval of professional standards in the field of healthcare" dated 24.01.2024 No. 46;
 - Order of the Minister of Healthcare of the Republic of Kazakhstan "On approval of model curricula on medical and pharmaceutical specialties" of 09.01.2023, № 4;
 - On amendments and additions to the Order of the Minister of Health of the Republic of Kazakhstan dated December 21, 2020 No. KR DSM-305/2020 "On approval of the nomenclature of specialties and specializations in the field of healthcare, nomenclature and qualification characteristics of positions of healthcare workers"
 - Order of the Minister of Education and Science of the Republic of Kazakhstan dated April 20, 2011 № 152 "On approval of rules of educational process organization by credit technology of education" (as amended on May 06, 2021)
 - Order of the Minister of Education and Science of the Republic of Kazakhstan from 30.10.2018 № 595 with amendments and additions as of 29.12.2021. "On approval of the Standard Rules of activity of educational organizations of respective types and kinds",
 - "Regulations on the Order and Procedures for the Development of Educational Programs" "SKMA" JSC from **22.04.2024y.**
 - Internal regulatory documents of SKMA JSC.
5. **Field of professional activity:** installation, maintenance and repair of medical equipment in health care facilities, at enterprises manufacturing and servicing pharmaceutical and medical equipment
6. **Objects of professional activity:** healthcare, chemical, pharmaceutical and food production, university, scientific laboratories.

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General information

№	Field Name	Note
1	Registration Number	
2	Code and Classification of the Field of Education	6B07 Engineering, manufacturing and construction Industries
3	Code and Classification of Training Areas	6B072 Industrial and manufacturing branches
4	Educational Program Group	B072 "Pharmaceutical production technology"
5	Name of the Educational Program	Digital Engineering in Pharmacy and Medicine
6	Type of Educational Program	Innovative Educational Program
7	Objective of the Educational Program	Training highly demanded specialists in the design, maintenance, and repair of pharmaceutical and medical equipment.
8	Level by ISCED	0720
9	Level by NQF	6
10	Level by SQF	6
11	Distinctive Features of the EP	Innovative
	Partner University (JEP)	
	Partner University (DDEP)	
12	List of competencies	<p>KC 1. The ability to use the basics of economic and legal knowledge in oral and written forms in professional activities</p> <p>KC 2. The ability to solve standard tasks of professional activity using information and communication technologies, taking into account the basic requirements for the maintenance of pharmaceutical and medical equipment</p> <p>KC 3. The ability to act in non-standard situations, to bear social and ethical responsibility for decisions made</p> <p>KC 4. The ability to maintain documentation using basic physico-chemical, mathematical and other natural scientific concepts and methods when working with</p> <p>KC 5 equipment. The ability to assess physiological conditions and pathological processes in the human body for the provision of primary pre-medical health care</p>

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		<p>KC 6. The ability to implement a set of measures, including the formation of a healthy lifestyle, prevention of the occurrence and (or) spread of diseases, their early diagnosis, identification of the causes and conditions of their occurrence and development</p> <p>KC 7. The ability to form the necessary documentation based on instrumental research</p>
13	Learning outcomes	<p>LO 1 To increase the efficiency of the state's healthcare system without corruption through engineering culture and international cooperation</p> <p>LO 2 To collect scientific and technical information and monitor equipment for forming judgments, taking into account social, ethical, economic and scientific considerations in the field of pharmaceutical industry and medicine development</p> <p>LO 3 Design and maintain modern equipment for pharmaceuticals, medicine, functional, laboratory and instrumental diagnostics based on the principles of engineering graphics, theoretical and applied mechanics, 3D modeling, metrology and standardization.</p> <p>LO 4 Apply entrepreneurial skills and knowledge of the legislative base of the Republic of Kazakhstan in the field of technical regulation to create and develop a business in the field of pharmaceutical and medical equipment maintenance in a changing technical and legal environment, taking into account the adoption of technical regulations and marketing ideas.</p> <p>LO 5 Apply acquired theoretical knowledge about human anatomy, physiology, and pathology to make decisions on the use, maintenance, and repair of medical equipment.</p> <p>LO 6 To organize the operation of modern robotic equipment, automated systems and mechanical devices.</p> <p>LO 7 Apply theoretical and practical knowledge to solve educational, practical and professional tasks in the field of maintenance and repair of pharmaceutical and medical equipment</p> <p>LO 8 Solve mathematical problems in order to build a computer model of the equipment, taking into account a series of appropriate pharmaceutical practices, information and measurement technologies and metrological characteristics.</p> <p>LO 9 Systematize knowledge on the maintenance of electrical and pneumatic components of equipment in order to improve software and information support for pharmaceutical and medical institutions.</p> <p>LO 10 To argue the choice of machines and apparatuses in the pharmaceutical industry and in medicine on the basis of technical design requirements, knowledge of general chemical technology, fundamentals of biochemistry and methods of sterilization in medicine.</p> <p>LO 11 To create medical products and pharmaceutical equipment elements based on design schemes, electronic document management, standards for medical equipment using artificial intelligence.</p>
14	Form of Education	Full-time

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15	Language of Instruction	Kazakh Russian
16	Total Credits	240
17	Awarded Academic Degree	Bachelor's degree in the educational program " Digital Engineering in Pharmacy and Medicine "
18	Availability of an Appendix to the License for the Training Program	KZ36LAA00011387 (019)
19	Accreditation Status of the Educational Program	
	Name of the Accreditation Body	Independent Agency for accreditation and Rating
	Accreditation Validity Period	2027
20	Course Information	Appendix A2

Appendix A1

MATRIX

correlation of learning outcomes of the educational program with the competencies being developed

	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11
KC1	x		x								
KC2	x		x			x	x		x		
KC3		x								x	+
KC4				x		x	x			x	
KC5					x			x			
KC6				x	x						
KC7			x	x		x		x	x		+

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Appendix A2

Competence/learning outcome attainment matrix

№	Name of the discipline	Brief description of the discipline (30-50 words)	Cycle (GED, BD, SD)	Component (MC, UC, EC)	Number of credits	Formed learning outcomes (codes)
1	2	3	4	5	6	7
Cycle of General Educational Disciplines (GED) University Component						
1	History of Kazakhstan	Improving the efficiency of the healthcare system and improving the quality of medical services towards the formation of modern Kazakhstan. The specifics of the development of the pharmaceutical industry, civil and political confrontation, the creation of social and industrial infrastructure, the formation of a new intelligentsia, socio-political prospects for development and spiritual modernization, the construction of a New Kazakhstan.	GED	RC	5	LO 1
2	Physical education	Formation of a person who is competitive and capable of physical self-improvement through the skills of building a personal educational trajectory throughout life for self-development and career growth, focused on a healthy lifestyle to ensure full-fledged social and professional activities through methods and means of physical culture.	GED	RC	8	LO 2
3	Foreign language	Formation of skills in using language and speech tools based on a system of grammatical knowledge to build communication programs in a foreign language, self-improvement and professional success; communication in oral and written forms in a foreign language to solve problems of interpersonal, intercultural and professional communication	GED	RC	10	LO 1
4	Kazakh (Russian) language	Russian and Kazakh oral and written communication skills for solving problems of interpersonal, intercultural and professional communication; information analysis in accordance with the communication situation and the ability to interpersonal social and professional communication in Kazakh and Russian languages	GED	RC	10	LO 1

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5	Information and communication technology	This course covers the fundamental concepts of information and communication technologies, including computer system architecture, types of software, database systems, data analysis and management, network technologies, cybersecurity, cloud technologies, multimedia technologies, smart technologies, fundamentals of artificial intelligence and its applications.	GED	RC	5	LO 1
6	Philosophy	Formation of skills in assessing the surrounding reality based on worldview positions formed by knowledge of the fundamentals of philosophy, which provide scientific understanding and study of the natural and social world by methods of scientific and philosophical knowledge; interpret the content and specific features of the mythological.	GED	RC	5	LO 2
7	The module" socio-political knowledge " (Sociology, Political Science, cultural studies and psychology)	Personality psychology: emotions, volitional processes, critical thinking, behavioral patterns. Sociology and political science: the individual and society, social inequality, health, politics, leadership, civil society. Cultural studies: nomadic culture, traditions and values of Kazakhstan, their influence on identity. Political culture, conflicts, world politics and international relations.	GED	RC	8	LO 1 LO 2
8	Legal, financial - economic, environmental and scientific knowledge	An integrated discipline based on economic, legal, environmental and scientific knowledge, the formation of one's own moral and civic position; general competencies in dealing with social, business, cultural, legal and ethical norms of Kazakh society for self-development and lifelong education, mobility in the modern world and critical thinking.	GED	EC	5	LO 1 LO 2
9	Fundamentals of Economics and Law	Formation of knowledge on the fundamentals of constitutional, administrative, civil and family, financial and labor, environmental and land and criminal rights of the RK. The market and competition. The monetary system. Features of the development of the national economy in the RK. Basic concepts of law and State-legal phenomena	GED	EC		LO 1 LO 2
10	Fundamentals of anti-Corruption Culture and Entrepreneurial Skills	Formation of an anti-corruption culture. Theoretical and methodological foundations of the concept of "corruption". Political power and corruption. Nepotism. The transformation of corruption in modern states. Anti-corruption policy in the Republic of Kazakhstan and the role of the social sphere in it. Legal responsibility for acts of corruption.	GED	EC		LO 1 LO 2

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11	Ecology, sustainable development and life safety, scientific research methods	Formation of an ecological worldview, obtaining systematic knowledge about the foundations of sustainable development of society and nature, safe human interaction with the environment; modern understanding of concepts, strategies and practical tasks of sustainable development at the national and global levels. Formation of skills in analyzing environmental processes; setting specific tasks and priorities for the sustainable development of nature and society and using the acquired knowledge to solve environmental problems. Mastering the methodological foundations of scientific knowledge. Application of scientific research methods in theory and practice.	GED	EC		LO 1 LO 2
TOTAL					56 credits	
		Cycle of Basic Disciplines/BD University Component /UC				
1	Metrology, standardization and certification of measuring instruments	Formation of skills for the production of high-quality competitive products and devices that meet consumer requirements. Methods and means of measurement and their metrological characteristics, automatic and computer measuring instruments, methodology and organization of standardization work, schemes and systems of product certification, standardization and certification of computer systems, technical documentation.	BD	UC	4	LO 3 LO 8
2	Pharmaceutical and medical commodity science	Formation of skills in working with regulatory and technical documentation for conducting commodity science analysis. Metallic and non-metallic materials. Corrosion of tools and anti-corrosion measures. Medical rubber products, glass and porcelain products. Sterilization and distillation equipment. Plastics and other non-metallic products. Classification of medical devices and pharmaceutical products.	BD	UC	4	LO 2 LO 4
3	Fundamentals of Economics	Acquisition of knowledge about the general principles of the organization of the production process, the mechanisms of competition and pricing of products, as well as the basics of economic knowledge necessary in the industry. Basic knowledge about the economic life of society at the level of micro and macroeconomics,	BD	UC	4	LO 2

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		laws and mechanisms of market functioning, features of the modern economy.				
4	Technical regulation of pharmaceutical and medical equipment	Acquisition of knowledge about the systems of technical regulations in the field of medical and pharmaceutical activities. The legal basis of technical regulation, the prerequisites and essence of the reform in the field of technical regulation, the procedure for the development and adoption of technical regulations, state control and supervision of compliance with the requirements of technical regulations, foreign experience in technical regulation.	BD	UC	5	LO 1 LO 4
5	Normal and pathological physiology 1	Formation of theoretical knowledge about the structural and functional organization of vital processes at the cellular, tissue, and organ levels and the disclosure of patterns of their normal development. Features of systems, cells and subcellular structures of a healthy organism.	BD	UC	5	LO 5
6	Normal and pathological physiology 2	Formation of theoretical knowledge about the structural and functional organization of vital processes at the cellular, tissue, and organ levels and the disclosure of patterns of their development in pathology. Introduction to pathological physiology. Damage and death of cells and tissues metabolic disorders in cells and tissues.	BD	UC	5	LO 5
7	Applied Mathematics	Skills development of the ability to use methods and models to solve applied problems. The main methods of solving computational problems, formulation and solution of optimization problems, the largest and smallest values of a function on a segment, means of mathematical modeling and computer technologies, operations of mathematical analysis, linear programming.	BD	UC	5	LO 8
8	Engineering graphics	Mastering the basic elements of machine-building drawing, descriptive geometry and computer graphics. Computer graphics, drawing design and geometric constructions, descriptive geometry elements, views, sections, sections, connections, construction of axonometric projections of flat shapes, assembly drawing.	BD	UC	5	LO 3 LO 11
9	Anatomy	Formation of skills in studying the morphology of the human body, its systems and organs, as well as structure and mutual arrangement. The form, structure, origin and development of the human body. The concept of	BD	UC	6	LO 5

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		anatomy is a morphofunctional characteristic of the respiratory system, nervous system, cardiovascular system, immune system, endocrine system, digestive system, musculoskeletal system.				
10	Fundamentals of automation and robotics	Formation of skills in the maintenance and repair of modern robotic equipment and automated systems. General information about automatic technical systems. Selection and justification of technical automation tools. Mechatronics and robotics. Theoretical foundations of robotics design. Fundamentals of automation of pharmaceutical and medical equipment. Features of building an intelligent robot control system.	BD	UC	5	LO 6
11	Electrical and electronics engineering	Formation of knowledge of the basic characteristics and principles of using electrical appliances in technical devices. The main provisions of the theory of electrical circuits, industrial electronics, and electrical measurements. Asynchronous and synchronous electric motors. Electronic and digital devices, their features and operating principle.	BD	UC	5	LO 6
12	Theoretical and applied mechanics	Acquisition of knowledge and practical skills in applied mechanics and resistance of materials. The role and place of mechanics in medical engineering. Theoretical foundations of mechanics. Methods of engineering calculations of structural elements and structures for strength, rigidity and stability. Fundamentals of the design of pharmaceutical and medical equipment machine parts.	BD	UC	6	LO 6
13	Fundamentals of microprocessor technology	Formation of skills in learning the basics of microprocessor technology. Principles of building microprocessor systems, architecture of microprocessor systems, processor functions, memory functions, methods of information exchange in a microprocessor system, organization of communication of a microcontroller with the external environment and time, development of a microprocessor system based on a microcontroller, low-level automation	BD	UC	5	LO 6 LO 9
14	Information and measurement technologies	Formation of skills for mastering the main stages of building automated measurement and control systems. Measurements and measuring systems, Structural circuits and their elements, digital converters and devices, input interface of measuring systems, measuring systems of time parameters, technical support of information and measuring systems, software of information and	BD	UC	4	LO 8

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		measuring systems.				
15	Electronic document management of equipment maintenance	Mastering the skills of working with electronic documents in the field of pharmaceutical and medical equipment maintenance. Standard organizational and administrative and special documentation. Tools for solving management tasks. Creating an electronic document, routing and sending, tracking the status of the document. Digitalization of document management using artificial intelligence.	BD	UC	5	LO 4 LO 11
16	Series of good pharmaceutical practices and standards for medical equipment	Acquisition of practical skills to implement the requirements of good practices. The GxP Series of Good Pharmaceutical Practices are the industry standards of the Gcp series (GLP, GCP, GMP). A list of standards that ensure compliance of medical devices with safety and effectiveness requirements, labeling requirements and operational documentation for them.	BD	UC	4	LO 8 LO 11
17	Mathematical simulation modeling	Formation of skills in creating and solving a mathematical model as a result of identifying the main, characteristic features of a phenomenon or process, and its defining features. Production models, balance sheet models, mathematical and computer modeling, simulation models of global systems, statistical hypothesis testing, random event modeling, queuing systems, inventory management models.	BD	UC	5	LO 8
18	Organization of business in the field of healthcare	Formation of skills for studying the main stages of business organization, from the formation of an idea to the implementation of a finished product. Conducting marketing research, analyzing the healthcare market and industry, business planning, managerial, financial and legal foundations and features of business organization in the pharmaceutical and healthcare industries.	BD	UC	5	LO 4
19	Educational practice	Familiarization with medical and pharmaceutical equipment. Pharmaceutical and medical devices, apparatuses, systems and complexes. Technical means in the pharmaceutical industry and the healthcare system. Technical support of the therapeutic and diagnostic process; classification of medical electronic devices, devices and systems.	BD	UC	2	LO 1 LO 2 LO 3
20	Production practice 1 (pharmaceutical equipment)	Familiarization with the structure and development prospects of a pharmaceutical company (practice base), the range of products. Activities aimed at expanding production. General and special requirements for	BD	UC	4	LO 5 LO 6

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		occupational health, safety and industrial sanitation. Repair and maintenance of pharmaceutical equipment.				LO 7
21	Production practice 2 (medical equipment)	Familiarization with the structure and prospects of development of medical institutions (practice bases), the range of products. Activities aimed at expanding the base of medical equipment. General and special requirements for occupational safety and health. Repair and maintenance of medical equipment.	BD	UC	4	LO 5 LO 6 LO 7
TOTAL					97	credits
		Cycle of Basic Disciplines /BD Elective Component /EC				
1	Fundamentals of algorithmization and programming of pharmaceutical equipment	Formation of skills for mastering the basic principles of modern programming of pharmaceutical equipment. The concept of an algorithm and its properties, elementary objects and their basic types, operations on objects, object-oriented and software-oriented programming, the main stages of creating a website, filling a website with graphic and informational content, the IEC62304 standard.	BD	EC	5	LO 9
2	Methods and technologies of programming medical equipment	Formation of skills in mastering the methods and technologies of programming medical equipment. Procedural, logical, functional, structural and modular programming, object-oriented programming information security, overview of various programming technologies, the main stages of website creation, filling the website with graphic and information content, IEC62304 standard, integrated медицинское программное обеспечение	BD	EC		LO 9
3	Fundamentals of biochemistry	Formation of knowledge at the modern scientific level on structural and metabolic biochemistry. Information on the chemical composition of biological systems and the structural organization of living matter, descriptions of the sequence of basic metabolic reactions, as well as the main directions of development of this branch of science and technology	BD	EC		LO 10
4	Pharmaceutical	Formation of skills for industrial activity as a mechanical engineer in	BD	EC	5	LO 1

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	industry machines and apparatuses	the pharmaceutical industry. Equipment for crushing, sorting and separating materials and heterogeneous systems, Equipment for mixing materials, Reactors, Equipment for the production of tablets, Equipment for the production of soft dosage forms, Equipment for the production of liquid dosage forms, Equipment for the production of patches, aerosols.				LO 10
5	Devices and systems in medicine	Formation of specialist skills for engineering in medical and biological practice. Methods of objective assessment of the functional state of various systems, organs and tissues of the human body at rest and under stress. Modern medical devices and systems, indicating their technical characteristics and operating principles used to diagnose various human diseases.	BD	EC		LO 1 LO 10
6	Fundamentals of industrial equipment digitalization	Formation of skills for systematization and expansion of knowledge about new information technologies in the pharmaceutical industry. Current state and prospects of digitalization in instrument engineering and electronics, Internet of Things (Industrial Internet of Things, IIoT), cloud computing, artificial intelligence, digital workplace, digital twin technology	BD	EC	4	LO 9
7	Digital signal processing in medicine	Formation of skills for systematization and expansion of knowledge in medical technology of new information technologies. Digital signals, the purpose of the field of application of digital signals, conversion of an analog signal to digital and vice versa, digital filtering, filtration methods, examples of modern medical technology, achievements of engineering ideas, materials science, information technology, automation, artificial intelligence.	BD	EC		LO 9
8	Pharmaceutical equipment design	Formation of knowledge and skills in designing pharmaceutical equipment. The regulatory framework for the design, the main stages of the design of pharmaceutical industries and equipment, the preliminary design of the product, the technical design of the product, the development of working design documentation for the product, 3D models	BD	EC	5	LO 3 LO 7 LO 11

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9	Design of medical equipment	Formation of skills in creating various products for a specific purpose with the design of their 3D models. Operational, social and economic requirements for medical devices, 3D modeling stages. IT in medicine. Development of 3D models in medicine and pharmacy.	BD	EC		LO 3
10	Methods and technologies of programming medical equipment	*Formation of skills in mastering the methods and technologies of programming medical equipment. Procedural, logical, functional, structural and modular programming, object-oriented programming information security, overview of various programming technologies, the main stages of website creation, filling the website with graphic and information content, IEC62304 standard, integrated медицинское программное обеспечение	BD	EC	5	LO 9
10	General chemical technology	Formation of skills of engineering and technical staff involved in the design, modernization, research and operation of chemical profile systems. Fundamentals of the methodology of designing the most important components of chemical technology systems, starting from the choice of resources and the method of production of a chemical product and ending with the development of the overall structure of the manufacturing system. Design of reaction technology.	BD	EC		LO 10
11	Manufacturing technology of medical devices	Formation of basic knowledge on the technology of manufacturing medical devices. Basic information about the technology of manufacturing medical devices. Methods and means of manufacturing, assembly and control of products and printed circuit boards used in modern production, as well as issues of product quality assurance and principles of organization of production of medical devices.	BD	EC		LO 9 LO 11
12	Methods of sterilization in medicine	Formation of basic knowledge on the theoretical and organizational foundations of sterilization in medicine. Methods and methods of sterilization of medical devices, advantages and disadvantages, the order of use in medical organizations. Directions of quality control of sterilization.	BD	EC		LO 10
TOTAL					19	

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					credits	
Profile Disciplines/PD University Component/UC						
1	Devices and complexes for functional diagnostics	Formation of skills in mastering devices and complexes for diagnosing the functional state of a person. An overview of devices and methods for diagnosing human functional conditions, the scope of functional diagnostics, the study of ventilation function of the lungs and respiratory mechanics, equipment for the study of electrical and mechanical activity of the heart and analysis of hemodynamics.	PD	UC	6	LO 3
2	Laboratory and instrumental diagnostic devices and systems	Formation of skills for mastering modern devices and diagnostic methods used in heart diseases. Fundamentals, indications for the study and signs of malfunction of devices and systems: electrocardiography, echocardiography, computed tomography of the heart, coronary angiography, ventriculography, radionuclide diagnostic methods, magnetic resonance topography, devices and laboratory diagnostic systems.	PD	UC	6	LO 3
3	Accounting of medical equipment in medical organizations of the Republic of Kazakhstan	Formation of skills to keep records of medical equipment in medical organizations of the Republic of Kazakhstan. The procedure and rules for the stages of monitoring the technical condition of medical equipment, a standard list of operations of the main types of technical condition control, periodic and routine maintenance, automated accounting systems for medical equipment.	PD	UC	5	LO 4 LO 9
4	Pharmaceutical equipment for the production of various dosage forms	Formation of operating principles and rules for the selection of equipment used in the production of finished medicines. Regulatory requirements for the production of medicines, technological schemes, material calculations, regulations, fundamentals of calculation and selection of technological equipment, description of the technological process, pharmaceutical equipment for soft, solid and liquid forms.	PD	UC	5	LO 4 LO 10
5	Computer-aided equipment design systems	Acquisition of practical skills in working with application software for equipment design tasks. Fundamentals of design automation of electronic devices and systems, programs for documenting design results using artificial intelligence, programs for modeling electronic devices at the level of structural and schematic diagrams, specialized	PD	UC	6	LO 11

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		computer-aided equipment design systems.				
6	Pre-graduate practice	Obtaining professional experience and checking the graduate's readiness for independent work. Consolidation of knowledge on the definition of standards for licensing, maintenance and repair of pharmaceutical or medical equipment, consolidation of skills in working with reference and scientific literature, collection of necessary material for the completion of the graduation project.	PD	UC	12	LO 1 LO 2 LO 4 LO 6 LO 7 LO 8 LO 9 LO 10 LO 11
TOTAL					40	credits
Profile Disciplines /PD Elective Component/EC						
1	Software applications for quality forecasting and control of pharmaceutical products	Mastering the skills of using software applications for quality forecasting and control. A general description of software applications for quality forecasting and control, integrated expert systems (IES), methodological foundations for building IES, main tasks, structure and stages of development of IES for quality control and forecasting of pharmaceutical products.	PD	EC	5	LO 9
2	Optimization of the medical equipment usage process	Formation of skills for studying an automated information system (AIS) in order to improve software and information support for administrative and business processes of a medical institution. Classification of medical information systems, organizational and technical aspects of maintenance and repair of medical equipment, information systems for automation of basic processes.	PD	EC		LO 7 LO 9
3	Pneumatic automation in pharmaceuticals	Formation of skills for solving problems based on the principles of building elements and systems of pneumatic automation. Purpose of pneumatic systems, graphical symbols of pneumatic circuit elements, pneumatic actuator control systems, implementation of sequential functions, pneumatic automation in pharmaceuticals: cylinders,	PD	EC	5	LO 5 LO 9

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		position sensors, valves, butterfly valves.				
4	Pneumatic automation in medicine	Formation of skills for solving problems based on the principles of building elements and systems of pneumatic automation. The purpose of pneumatic systems, graphical symbols of the elements of pneumatic circuits, control systems for pneumatic actuators, the implementation of sequential functions, devices for artificial ventilation, artificial blood circulation and artificial heartbeat.	PD	EC		LO 5 LO 9
5	Development of technical requirements for the design of pharmaceutical equipment	Formation of skills in developing technical requirements for the design of pharmaceutical equipment. Stages of development of technical requirements for the design of pharmaceutical equipment, requirements for purpose, reliability, safety of life, ergonomic and aesthetic requirements, economic, patent and legal requirements, requirements for standardization of pharmaceutical equipment.	PD	EC	5	LO 2 LO 10 LO 11
6	Development of technical requirements for the design of medical equipment	Formation of skills in developing technical requirements for the design of medical equipment. Stages of development of technical requirements for the design of medical equipment, requirements for purpose, reliability, safety of life, ergonomic and aesthetic requirements, economic, patent and legal requirements, standardization requirements for the design of medical equipment.	PD	EC		LO 2 LO 10 LO 11
7	Remote Pharmaceutical Equipment Service	Production data generation and monitoring of industrial equipment in order to increase production efficiency. Maintenance rules, coordination of service activities, modern remote maintenance technologies, viewing error messages and hardware settings, remote adjustments and software repairs.	PD	EC	5	LO 3 LO 9
8	Additive technologies in pharmaceuticals and medicine	Formation of students' theoretical knowledge and practical skills in the field of digital engineering for the design and creation of customized medical and pharmaceutical products. Integration of digital modeling, engineering analysis and selection of biocompatible materials. Application of modern additive methods in pharmaceutical production and medicine.	PD	EC		LO 11
7	Writing and defending graduation	To determine the student's readiness for independent work in the conditions of modern production, science, technology, culture, as well as the level of his	PD	UC	8	LO 1 LO 2

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projects	professional competence. The application of theoretical knowledge and practical skills in independent work in solving topical issues developed in the diploma design. The graduation project should be of a research nature.				LO 3 LO 4 LO 5 LO 6 LO 7 LO 8 LO 9 LO 10 LO 11
TOTAL				20	credits
GRAND TOTAL				240	credits