MINISTRY OF HIGHER EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

NON-PROFIT JOINT-STOCK COMPANY "ALMATY UNIVERSITY OF POWER ENGINEERING AND COMMUNICATIONS NAMED AFTER GUMARBEK DAUKEYEV"

Institute of Automation and Information Technology

"Approved"
Director of IAIT
Fedorenko I.A.
"27" 05 2023

EDUCATIONAL PROGRAM DEVELOPMENT PLAN FOR 2023-2028

6B07125-BIOTECHNICAL AND MEDICAL SYSTEMS AND APPARATUS

Educational Field Code and Classification - 6B07 Engineering, Manufacturing, and Construction Industries

Code and classification of training areas - 6B071 Engineering and engineering

Name of the educational program groups - B064-Mechanics and metalworking

Bachelor of Engineering and Technology in Biotechnical and Medical Systems and Devices

ISCED level: 6
NQF level: 6
ORK level: 6
Duration of study: 4 years
Amount of credits: 240

Almaty 2023

CONTENT

1. Information about the educational program

The modular educational program "6B07125 - Biotechnical and Medical Systems and Apparatus" was developed on the basis of the Law of the Republic of Kazakhstan "On Education" dated July 27, 2007 and regulatory documents: State Compulsory Standard of Postgraduate Education (Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 No. 604), Model Rules for the Activities of an Organization of Higher and Postgraduate Education (Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 30, 2018 No. 595), Rules for the Organization of the Educational Process Using Credit Technology of Education (Order of the Ministry of Education and Science of the Republic of Kazakhstan dated April 20, 2011 No. 152, as amended on October 12, 2018 No. 563), National Qualifications Framework (Approved by the Protocol of March 16, 2016 by the Republican Tripartite Commission on Social Partnership and Regulation social and labor relations), regulating the requirements for a graduate with an academic bachelor's degree in OP 6B07125 - Biotechnical and medical systems and devices"

1.1.Analysis of the medical equipment market in Kazakhstan

One of the key areas of state healthcare policy is creating favorable conditions for equipping medical institutions with modern diagnostic, treatment, and preventive equipment. An effective medical equipment market is designed to fulfill this complex task.

Research has shown that, given the emergence of new economic relations, this market is a steadily developing element of the country's economic complex. New forms of ownership and competition have become established, the number of economic entities has increased, and the volume and range of products has expanded.

A study of the characteristics of the Kazakhstani medical equipment market indicates the development of processes of integration, specialization, and concentration of production, with increasing competition between enterprises, firms, and companies for a dominant position.

A characteristic feature of the market is the presence of foreign capital and increasing volumes of imported products. The leading Kazakhstani manufacturers in the market of medical equipment and instruments are JSC Aktyubrentgen, LLP MedRemZabodHoldig, LLP Saiman Corporation, LLP Kazmedpribor holding, LLP Ecopharm international, LLP Medstarexport, LLP Kazmedpribor, LLP Medtrading, LLP Bark technology, LLP Juldyz kenan co., ltd, LLP Marai e7 group (marai e7 group) , LLP Almerek, LLP Rahimzade, LLP Almerek plus (Almerek plus) , LLP Med365, LLP Innovative production group, Additional Liability Partnership Bik orken, LLP Kazmedpribor Astana, LLP Picasso dentallab, LLP Rembrand, LLP Oralmedregion, TOO `Svetokom plus`.

The main types of medical equipment produced in the Republic are:

- apparatus based on the action of X-ray radiation for medical, surgical, dental or veterinary use;
- electrodiagnostic equipment used in medicine;
- instruments and devices used in dentistry (except drills);
- ultrasonic lithotripters;
- equipment for nerve stimulation; other devices and instruments;
- therapeutic devices and equipment;
- artificial respiration devices;
- equipment for ozone therapy, oxygen therapy, aerosol therapy, artificial lung ventilation devices.

The Akmola region demonstrates the best production indicators with an output volume of 1.9 thousand units per year.

An import-oriented model has emerged in the Kazakhstani medical equipment market, with products from foreign manufacturers accounting for over 99% of the market.

In the medical equipment market in 2020, imports exceeded domestic production by 1,724.8 times, with India leading the import market (over 30%). Besides India, medical equipment is also

supplied by countries such as China, Indonesia, Poland, Germany, Spain, Russia, Italy, Thailand, Sweden, and others.

The following types of medical equipment are imported to Kazakhstan:

- electrocardiographs;
- ultrasound scanning equipment;
- magnetic resonance imaging;
- scintigraphic equipment;
- drills;
- instruments and equipment for measuring blood pressure;
- endoscopes;
- hemodialysis equipment;
- diathermic equipment;
- equipment and devices for anesthesia;
- equipment for nerve stimulation;
- ultrasonic lithotripters;
- hearing aids;
- pacemakers;
- computed tomography scanners;
- equipment based on X-ray radiation;
- equipment based on the use of alpha, beta and gamma radiation;
- other electrodiagnostic equipment.

At a meeting of the Expert Council of the Republican Center for Health Protection of the Ministry of Health of the Republic of Kazakhstan (December 8, 2020, Minutes No. 20), analyzing the maintenance of medical equipment in government organizations of the Republic of Kazakhstan, it was noted that "maintenance of expensive equipment is performed by unauthorized service companies, and there is a shortage of specialists to maintain medical equipment. Currently, to address these issues, amendments have been made to regulatory and legal acts, the warranty period has been extended to five years, and the creation of a school of biomedical engineers in the Republic of Kazakhstan has been considered."

Biomedical engineers are trained in biomedical engineering, biotechnical and medical devices and systems at 47 Russian universities. In the United States, 192 universities offer training in the specialty "Biomedical engineering." In Kazakhstan, undergraduate training in this field is provided by Karaganda State Technical University (6B06103 IT-medicine), Aktobe Regional University named after K. Zhubanov (6B06106 IT medicine), and East Kazakhstan Technical University named after D. Serikbayev (6B07109 Medical Engineering). Master's degree training in biomedical engineering is provided by Nazarbayev University (IT-medicine), Satbayev University (7M07106 - biomedical engineering, 8D07105 - biomedical engineering), and joint training between Al-Farabi Kazakh National University and KBTU (7M05115 - Biomedical Engineering).

2. Description of the educational program

2.1.Objectives of the educational program

The objectives of the educational program "Biotechnical and Medical Systems and Devices" are:

- development of students' social and personal qualities through the formation of universal, general professional and professional competencies that contribute to their social mobility and stability in the labor market;

- meeting the needs of the Republic of Kazakhstan for qualified personnel by training highly qualified specialists for enterprises developing and producing medical devices, operating and servicing medical systems, complexes and equipment of healthcare institutions;

- conducting new medical research using technical and computer means, creating and transitioning to new software for processing diagnostic information, creating systems for collecting, analyzing, processing, and storing medical information; databases and knowledge bases, forecasting and decision-making systems.

A distinctive feature of this educational program is its focus on preparing graduates capable of using the achievements of modern science and technology to monitor and manage the state of living systems, which is characterized by a high degree of demand in the labor market.

To develop in graduates civic responsibility and legal awareness, spirituality and culture, initiative, independence, tolerance, the ability to successfully socialize in society and actively adapt to the labor market.

2.2.Objectives of the educational program:

1. Prepare specialist,who has knowledge in the field of development, production, maintenance and repair of biotechnical and medical devices and systems, instruments, devices and means of biomedical engineering.
2. To train students in the research and evaluation of new medical equipment, repair and modernization of complex medical equipment, maintenance and testing of medical measuring instruments, testing of the performance and safety of medical equipment, testing and commissioning of new and returned medical equipment, and monitoring the performance of medical equipment.
3. The graduate should know the research methodology in the field of data science (setting research goals, collecting data, processing and transforming data, examining data, building models and selecting methods, presenting and visualizing results), methods and approaches to standardizing and transforming data, machine learning methods (basic methods of classification and clustering), and ways of organizing data storage.
4. The graduate must know the methodology for training medical personnel in the rules of effective and safe operation of medical equipment, and the organization of effective information support for the activities of medical and preventive institutions.
5. Graduates must be able to prepare and enter reporting documentation related to the circulation of medical equipment in medical and preventive institutions, and plan the work of medical units equipped with complex medical equipment.

2.3. Mechanisms for planning the educational program

The following planning mechanisms are used in managing educational programs. At the long-term planning level, overall priority areas and strategic goals for the development of all educational programs are identified, and program-specific metrics and indicators are included.

Long-term planning documents include the university's vision, mission, strategy, quality policy, and development plan. Short-term development plans for educational programs are based on these documents.

Short-term planning includes three levels.

At the university level, short-term planning is represented by the Gumarbek Daukeev AUPET Quality Goals, improvement plans, advisory body work plans, and annual work plans by area. All of these documents, as well as the plans of auxiliary structural units, address issues related to specialist training and address the challenges of implementing specific programs.

At the departmental level, educational program development planning is reflected in the Institute and Graduate Department Quality Goals, comprehensive institute plans, and department work plans. Institute and department plans must include deadlines for completing activities, responsible persons, and a column for recording completion. Short-term plans are required to be aligned with the university's mission, strategic goals, and objectives, and to include a section on operational improvement. This set of plans is the primary mechanism for developing educational programs and ensuring their quality. These plans address educational, methodological, practice-oriented, and logistical aspects of educational program development.

At the individual level, planning is represented by individual plans of the PPS.

3. Measures to reduce the impact of risks on the educational program

The successful implementation of an educational program can be affected by various types of risks, and as a result, preventive measures have been developed to reduce them.

The following measures are used in the implementation of the educational program for risk reduction:

No. PP	Name of possible risks	Measures to eliminate them
1.	Decrease in the number of students studying in the educational program	Development of a comprehensive plan for career guidance work in schools and colleges in Almaty and other regions. Active work in social networks. Organizing joint scientific and educational projects with schoolchildren, including master classes in schools and colleges. Providing discounts on tuition for certain categories.
2.	Insufficient knowledge of foreign languages by applicants	Conduct a diagnostic test of foreign language proficiency upon admission. Conduct an active foreign language club. Motivate students with the opportunity to pursue academic mobility and double-degree programs at the University's international partner universities.
3.	Provision of educational methodological literature on professional disciplines in the state language	Activate work PPS By development on the state language and the introduction of electronic educational publications into the educational process. Plan the annual release of scientific and educational-methodological materials by scientists and the faculty of the department literature according to the university subject plan.
4.	The influence of the ranking of educational programs of competing universities on the educational program "Biotechnical and medical systems and devices"	Activate high-quality preparation for participation in national, regional, and state international rankings, such as Atameken.
5.	Perfectingdigital material and technical base can lead to rapid aging of the existing base	Timely and planned procurement of modern equipment and constant replenishment of the instrument and tool inventory. Enter into agreements with companies and enterprises to establish laboratory facilities, as well as to facilitate the joint use of these companies' and enterprises' laboratory facilities in the educational process.
6.	Termination of cooperation agreements with industrial partners.	Concluding contracts with leading industry companies for internships/training and subsequent employment (with extension).
7.	Increase in the average age of the teaching staff	Inviting young professionals with advanced degrees and/or master's degrees. Creating favorable conditions for career growth of young specialists.
8.	Weak activity of the teaching staff in publishing scientific papers in journals with high indexes citation	Develop a publication plan for faculty members in KOKSON journals and international publications with a non-zero impact factor. Actively participate in competitions announced by the Ministries of the Republic of Kazakhstan and international organizations.

		to receive grants for funded research

4. List of activities of the educational program implementation plan

To successfully implement the Educational Program Development Plan, the Department of Automation and Control plans to systematically implement measures including:
- improving the educational program taking into account the opinions of potential employers;
- drawing up a plan for the publication of textbooks, teaching aids and methodological guidelines for the educational program;
- active implementation of academic mobility of students and teaching staff;
- expansion of scientific cooperationand partnerships with leading foreign universities and research centers, attracting leading foreign scientists to conduct scientific research and give lectures to students;
- increasing the number of teaching staff who speak a foreign language;
- equipping educational laboratories with modern equipment;
- submission of applications for competitions on scientific projects, Ministry of Education and Science of the Republic of Kazakhstan, etc.;
- publication of scientific articles in journals included in the Thomson databases Reuters, Scopus and Springer, in scientific journals with impact factor;
- continuous monitoring of graduates' employment;
- concluding agreements with specialized enterprises for students to undergo professional and pre-graduation internships.

5. Mechanism for implementing the development plan educational program

Conduct targeted work to increase the number of state educational grants, grants from local executive bodies, and grants from employers for educational programs based on career guidance work among school and college graduates.

To implement a high-quality educational program, the department's faculty and staff will develop catalogs of elective courses with the direct participation of employers. The department's faculty will actively implement new innovative teaching and research technologies through academic mobility with international partner universities and companies. Ensuring a high percentage of employed graduates of the educational program will be achieved by organizing and holding an annual "Graduate Fair" with the involvement of employers from all sectors and various types of business entities in the regions of the Republic of Kazakhstan.

Management of innovations and implementation of research results in the educational process cover all elements of educational activities, while the forms of implementation of research results in the educational process are as follows: delivering problem-based lectures on the topic of research in connection with the future professional activities of students; introduction of new theoretical sections in lectures and seminars; introduction of new works in laboratory practical training in the curriculum of the discipline; writing by students of abstracts, term papers, theoretical reviews on research; off-site lectures and practical classes at the base of research institutes and partner enterprises of AUES related to research; implementation by students of research projects in the scientific areas of the department; involvement of students in experimental research work on the topic of research; preparation of students for participation in scientific conferences of intra-university and extra-university scale; development and design by students of stands, posters, slides, multimedia presentations on the problems and results of research for the department.

6. Evaluation of the socio-economic effectiveness of the implementation of the educational

program development plan

As a result of the implementation of the development plan for the OP, it is expected that the following socio-economic effects will be achieved:

- improving the quality of professional education and, as a consequence, the competitiveness of specialists;
- training graduates who meet the needs of potential employers;
- increasing the role of employers in training professional personnel;
- increasing demand for qualified personnel, optimizing their age structure;
- expanding opportunities for professional self-realization of young people;
- preventing the outflow of promising teaching staff to other sectors;
- updating the educational and material base (educational, laboratory, computer and technological base that meets modern requirements and standards).

7. Development programs for the educational program "Biotechnical and Medical Systems and Devices"

Events

No.	Events	Completion form	Responsible persons	Execution deadlines
1	Improvement OP"Biotechnical and medical systems and devices" with the participation of potential employers - domestic and foreign.	OP	Department	2023-2027
2	Promotion qualifications, degrees of the teaching staff byinternships in Kazakhstan and abroad	Certificates	Head of the Department, Faculty of the Department	2023-2027
3	Activation of relations with foreign scientists with the aim of implementing joint scientific research and preparing educational and methodological literature	Projects underway	Department's teaching staff	2024-2027
4	Enhanced participation of leading scientists of the department in competitions of the Ministry of Education and Science of the Republic of Kazakhstan for grant funding of scientific projects	Project	Department's teaching staff	2024-2027
5	Involvement of leading domestic and foreign scientists and employers in delivering lectures	Classes conducted	Department's teaching staff	2024-2027
6	Signing agreements with enterprises on conducting industrial training for students	Agreement	Department's teaching staff	2024-2027
7	Organization of laboratories for medical equipment	Agreements with companies	Department's teaching staff	2023-2027
8	Signing memorandums with leading medical organizations, companies, and foreign universities	Memorandum	Department's teaching staff	2022-2027
9	Organization of two diploma educational programs with leading universities in Europe and Russia	Agreement, memorandum	Department's teaching staff	2023-2027
10	Implementation academic mobility studentsand teachers	Study and internship at a foreign university, certificates	Department, Institute	2023-2027

11	Participation of the teaching staff in the editorial boards of leading domestic and foreign scientific journals in the field of medical technology		Department's teaching staff	2024-2027
12	Providing the educational institution with information and library resources	Purchasing literature	PPS, Library	2023-2027
13	Passing the initial accreditation of the educational program in the Republican accreditation agencies	Certificate	PPS	2024
14	Consideration of the development plan for the educational program at an extended meeting of the department with the participation of employers and students	Minutes of the meeting	Head of Department	2024-2027
15	Review and approval of the development plan for the educational program by the Academic Council of the Institute	Minutes of the meeting	Head of Department	2024-2027

8. SWOT ANALYSIS

Strengths	Weaknesses
• The educational program was developed jointly with employers. • Provision of modern equipment for educational laboratories. • Qualified teaching staff. • Involvement of practicing specialists with extensive experience working at large enterprises in various industries in the educational process as teaching staff. • The need from enterprises for specialists in this educational program. • Own buildings and logistics. • Stable financial position of the university. • Conducting fundamental and applied scientific research. • Favorable conditionsfor cultural and intellectual development, formation of a healthy lifestyle of students and staff. • Interaction of the university with employers and specialized research institutes. • Established relationships with industrial enterprises enable the implementation of research and development results into production processes. • Availability of double degree programs with a foreign university. • A developed social support policy for students (tuition discounts, incentives for winning Olympiads, competitions and scientific research, payments from the Board of Trustees, a grant and scholarship from Gumarbek Daukeev.	• Not all regions have partners for students to undergo all types of practical training. • Insufficient level of publications in international peer-reviewed journals. • Aging of the teaching staff and practitioners, low staff turnover. • The insufficient level of English proficiency among teaching staff prevents them from implementing international cooperation on a broad and effective basis. • Insufficient provision of the educational process with educational literature in the state and English languages. • Low level of popularization, stimulation and involvement of young teachers and students in the implementation of scientific projects and developments. • Low publication activity of faculty and students. • Low student enrollment
Possibilities	**Threats**
• Having connections with global vendors makes it possible to create powerful training centers. • Certification of graduates by recognized organizations. • Advanced training for teaching staff on preferential terms in global companies. • The attractiveness of the educational program for students and leading teaching staff of other universities. • Attracting young practitioners. .	• Rapid changes in the labor market require adjustments to the OP. • Obsolescence of laboratory equipment, software and computer equipment. • The increase in the number of students will cause a shortage of classroom and laboratory facilities, as well as teaching staff. • Problems with internship places in the regions against the backdrop of an increasing number of students. • Frequent changes in regulatory frameworks in the field of education and science. • Deterioration in the quality of the contingent due to the low level of training of schoolchildren and college graduates. • The outflow of qualified teachers and scientists to other industries (commercial) with higher

	incomes, as well as to other universities. • The outflow of strong students to other universities, including foreign ones.

Head of the Department of AC Abzhanova L.K.

Head of the EP
"Biotechnical and medical systems and devices" S. Zhusupbekov

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"Biotechnical and medical systems and devices" — Zhusupbekov S. S.