

Satbayev University

**A. Burkibayev Institute of Industrial Automation and Digitalization
The Department “Robotics and Engineering Tools of Automation»**

CURRICULUM PROGRAM

**“BIOMEDICAL ENGINEERING”
Master of engineering and technology
of the educational program “7M07132-Biomedical Engineering”
Master of engineering and technology**

on the basis of the vitiated Specialty Classifier: 6M071600 - Instrumentation

1st edition




in accordance with the State Educational Standard of Higher Education 2018

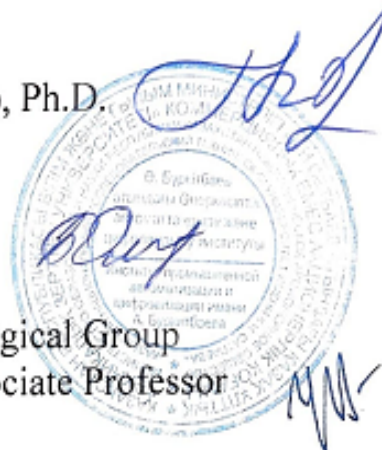
Almaty 2020

Developed:	Reviewed: meeting of the AC Institute	Approved by :EMC of SU	Page 3 of 26
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The program is drawn up and signed by the parties:

from Satbayev University:

- | | | |
|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------|
| <p>1. Head of the Department of Robotics and Engineering Tools of Automation (R&ETA), Ph.D.</p> |  | K. Ozhikenov |
| <p>2. Director of the Institute of Industrial Automation and Digitalization, PhD</p> |  | B. Omarbekov |
| <p>3. Chairman of the Educational and Methodological Group of the Department of “R&ETA”, Ph.D, Associate Professor</p> |  | Zh. Ualiyev |



From the employer:

Director of LLP “MedRemZavodHolding” A. K. Dzhumagulov
 Deputy Director for IIT of LLP “Saiman Corporation” K. I. Baibekov

Approved at the meeting of the Educational and Methodological Council of the Satbayev University, (Protocol #3 of 19.12.2018)

Qualification:

Level 7 of the National Qualifications Framework:
 7M07 Engineering and Engineering (Master’s degree):
 7M071 Biomedical Engineering

Professional competencies: in the field of research methodology; in the field of scientific activity in higher educational institutions; in matters of modern educational technologies; in the implementation of scientific projects and research in the professional field; in the field of information analysis.

BRIEF DESCRIPTION OF THE PROGRAM:

1 Goals of the educational program

1 Objectives of the educational program

The objectives of the Biomedical Engineering Educational Program are:

to meet the needs of students for intellectual, creative and professional development by acquiring knowledge and skills in the field of biomedical technology and systems;

organization of master's training that allows all graduates to continue their education with the aim of obtaining a PhD in the field of new high-tech biomedical engineering for diagnostics, therapy and surgery, operation and maintenance of medical systems, complexes and devices;

meeting the needs of the Republic of Kazakhstan in qualified personnel by training specialists to conduct new medical and biological research using technical and computer tools, creating structures of problem-oriented systems, creating and switching to new software for processing diagnostic information in real time, complexes for collecting, analyzing, processing and storing medical and biological information; databases and knowledge, forecasting and decision-making systems, and biological experiments using tools and hardware and software.

2 Types of employment

Types of professional activities that graduates who have mastered the master's program are preparing for:

- research organization;
- design Department;
- organizational and managerial structure;
- installation and commissioning;
- service and operational documentation;
- project-technological;

Master's degree in the field of training "Biomedical Engineering" should be prepared to solve professional tasks in accordance with the profile of the master's program and the types of professional activities:

research activities:

-development of programs for scientific research and technical development, preparation of individual tasks for performers;

- collection, processing and systematization of scientific and technical information on the topic of planned research, selection of methods and tools for solving formulated tasks, preparation of tasks for performers;

- mathematical modeling of research technologies for biological objects and biotechnical systems for various purposes using standard software tools;

- development of physical, phenomenological, mathematical and information-structural models of biological objects and processes, assessment of their adequacy, determination of a set of independent indicators that characterize the studied biological object and process;

- organization and participation in conducting biomedical, environmental and ergonomic experiments, collection, processing, systematization and analysis of research results;

- preparation of scientific and technical reports in accordance with the requirements of regulatory documents, preparation of reviews and preparation of publications based on the results of conducted biomedical and environmental studies;

- analysis of patent materials and preparation of applications for inventions and industrial designs;

design and development activities:

- analysis of the state of scientific and technical problems by selecting, studying and analyzing literary and patent sources in the field of biotechnical systems and technologies;

- determination of the purpose, setting of design tasks, preparation of technical specifications for the performance of design works in the field of biotechnical systems and technologies;

- design of devices, devices, systems and complexes for biomedical and environmental purposes taking into account the specified requirements;

- development of design documentation in accordance with methodological and regulatory requirements.

organizational and managerial activities:

- development of organizational and technical documentation (work schedules, instructions, plans and estimates) and established reporting on approved forms;

- organization of work of small groups of performers involved in research, design and experimental research;

- control over the implementation of measures to prevent industrial injuries, occupational diseases, and prevent environmental violations in the process of research and operation of biological medical systems;

design and technological activities:

- development of technical specifications for the design of technological processes and production schemes for biomedical and environmental equipment using automated systems of technological pre-production;

- design of technological processes for the production of biomedical and environmental equipment using automated systems of technological pre-production;

- development of technological documentation for designed devices, devices, systems and complexes for biotechnical, medical and environmental purposes;

- ensuring the manufacturability of products and manufacturing processes, assessing the economic efficiency of manufacturing processes for biomedical and environmental equipment, as well as biotechnical systems in other areas;

- author's support of the developed devices, devices, systems and complexes at the design and production stages;

installation and commissioning activities:

- participation in verification, adjustment, adjustment, evaluation of equipment condition and configuration of biomedical systems for various purposes, including both technical means and software control systems;

- participation in interfacing software and hardware complexes with technical objects as part of biomedical systems, in conducting tests and commissioning prototypes of such systems;

service and maintenance activities:

- participation in verification, adjustment, adjustment and assessment of the state of biomedical systems for various purposes, as well as their individual subsystems, in the setting up of control hardware and software complexes;

- preventive control of technical condition and functional diagnostics of biomedical systems for various purposes, as well as their individual subsystems;

- preparation of operating instructions for biomedical systems and their hardware and software, development of routine testing programs;

- preparation of applications for equipment and components, preparation of technical documentation for equipment repair;

3 Objects of professional activity

The objects of professional activity of the graduate are:

- biomedical engineering, including information-sensory, Executive and control modules, their mathematical, algorithmic and software, methods and means of their design, modeling, experimental research and design;

- theoretical and experimental studies, analysis of signals, analytical relation for the optimum processing of multidimensional signals, mathematical foundations of pattern recognition, processing, identification and synthesis of speech signals, problem-oriented software systems in biomedical practice, the kinds of provisions for biomedical research, principle that gains structure the problem-oriented system, message processing of diagnostic information in real time, too complex for the collection, analysis, processing and storage of biomedical information; data and knowledge bases, systems of forecasting and decision-making software systems, health-technical support of medical institutions.

PASSPORT OF THE EDUCATIONAL PROGRAM

1 Scope and content of the program

The term of study in the master's program is determined by the volume of academic credits mastered. When the established amount of academic credits is mastered and the expected learning outcomes for obtaining a master's degree are achieved, the master's degree program is considered fully mastered. In the profile master's program, at least 90 academic credits with a study period of 1.5 years are awarded.

Planning of the content of education, the way of organizing and conducting the educational process is carried out by the University and scientific organization independently on the basis of credit technology of training.

The master's program in the relevant field implements educational programs of postgraduate education for the training of managerial personnel, with in-depth professional training.

The contents the master's program consists of:

- 1) theoretical training, including the study of cycles of basic and profile disciplines;
- 2) practical training of undergraduates: various types of internships, scientific or professional internships;
- 3) experimental research work, including the implementation of a master's thesis (project), for a specialized master's degree program
- 4) final certification.

The content of the OP "Biomedical Engineering" within the specialties 6M071600 - Instrument engineering, 6M073200 - Standardization and certification, 6M072200 - Polygraphy is implemented in accordance with the credit technology of training and is carried out in the state and Russian languages.

Educational program "Biomedical Engineering" identifies the full range of academic disciplines, grouped in cycles: basic (BD) and majors (PD), indicating the complexity of each subject in academic hours and credits established by the State compulsory standards of higher and postgraduate education approved by order of MES RK №604 dated October 31, 2018.

The DB cycle includes studying academic subjects and passing professional practice. The PD cycle includes academic disciplines and types of professional practices. The programs of disciplines and modules of the DB and PD cycles are interdisciplinary and multidisciplinary in nature, providing training at the junction of a number of areas of knowledge.

Final certification is carried out in the form of writing and defending a master's thesis.

Objectives of the educational program:

- development of students through research activities, critical thinking, development of professionally oriented skills and abilities;

- using highly professional experience of teaching undergraduates in various educational environments;
- training a new competitive generation of technical specialists for the labor market;
- developing an environment that welcomes and supports people from different cultures, and creating an atmosphere of striving for knowledge, academic integration and intellectual motivation;
- conducting research, conducting educational activities based on world best practices, and developing their own brand of training specialists;
- development of cooperation "University-industry" to meet the requirements of the labor market for technical specialists, to improve the quality of educational programs for training specialists for the economy and business sector;
- development of additional educational and training programs using multimedia, new teaching technologies for organizing learning based on the principle of lifelong learning;
- establishing partnerships with other universities and organizations to improve the quality of education, to support technical and cultural ties.

2 Requirements for applicants

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established pattern and confirm the level of English language proficiency with a certificate or diplomas of the established pattern.

The procedure for admitting citizens to the master's program is established in accordance with the "Standard rules for admission to study in educational organizations that implement educational programs of postgraduate education".

The formation of a contingent of undergraduates is carried out by substituting a state educational order for the preparation of specialized personnel, as well as paying for training at the expense of their own funds of citizens and other sources. The state provides citizens of the Republic of Kazakhstan with the right to receive free postgraduate education on a competitive basis in accordance with the state educational order, if they receive this level of education for the first time.

At the "entrance", the master's student must have all the prerequisites necessary to master the relevant educational program of the master's degree. The list of necessary prerequisites is determined by the higher educational institution independently.

In the absence of the necessary prerequisites, the master's student is allowed to master them on a paid basis.

3 Requirements for completing training and obtaining a diploma

Degree/ qualifications awarded: the Graduate of this educational program is awarded the academic degree "master of engineering and technology» in the direction of.

A graduate who has completed a master's degree program must possess the following General professional competencies:

- ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities;
- ability to independently formulate research goals, establish a sequence of solving professional tasks;
- the ability to apply in practice knowledge of fundamental and applied sections of disciplines that determine the direction (profile) of the master's program;
- ability to choose professionally and creatively use modern scientific and technical equipment for solving scientific and practical problems;
- ability to critically analyze, present, protect, discuss and disseminate the results of their professional activities;
- proficiency in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;
- willingness to lead the team in the sphere of their professional activities, tolerant of social, ethnic, confessional and cultural differences;
- readiness to communicate in oral and written forms in a foreign language to solve the problems of professional activity.

A graduate who has completed a master's degree program must possess professional competencies that correspond to the types of professional activities that the master's degree program focuses on:

research activities:

- ability to create mathematical models, mathematical foundations of pattern recognition, processing, identification and synthesis of speech signals, typical structures of a problem-oriented system, software tools for processing diagnostic information in real time;
- conduct optimal processing of multidimensional signals, types of medical and biological research supplies;
- ability to develop and apply new high-tech biomedical engineering in diagnostics, therapy and surgery, operation and service of medical systems, complexes and machines systems for collecting, analyzing, processing and storing biomedical information; data and knowledge bases, systems of forecasting and decision-making software systems, health-technical support of medical institutions;
- ability to develop methods of conducting experiments and conduct experiments on existing models and samples of biomedical systems and their subsystems, process results using modern information technologies and technical means;
- willingness to prepare analytical reviews and scientific and technical reports based on the results of work performed, to prepare publications on the results of research and development;
- ability to analyze scientific and technical information, generalize domestic and foreign experience in the field of biomedical systems, conduct patent search;

- the ability to implement in practice the results of research and development carried out individually and as part of a group of performers, to ensure the protection of intellectual property rights;

design and development activities:

- readiness to lead and participate in the preparation of a feasibility study of projects to create biomedical systems, their subsystems and individual modules;

- ability to prepare technical specifications for the design of biomedical systems, their subsystems and individual devices using standard Executive and control devices, automation tools, measuring and computer technology, as well as new devices and subsystems;

- the ability to participate in the development of design and project documentation of biomedical systems, in accordance with existing standards and specifications;

- willingness to develop methods for conducting experimental research and testing of biomedical systems, the ability to participate in conducting such tests and processing their results;

organizational and managerial activities:

- ability to organize the work of small groups of performers;

- willingness to develop technical documentation (work schedules, instructions, plans and estimates) in accordance with approved forms;

- willingness to apply methods of prevention of industrial injuries, occupational diseases, prevention of environmental violations;

design and technological activities:

- ability to develop technical specifications for designing technological processes and production schemes of biomedical and environmental equipment using automated systems of technological pre-production;

- ability to design technological processes for the production of biomedical and environmental equipment using automated systems of technological pre production;

- development of technological documentation for designed devices, devices, systems and complexes for biotechnical, medical and environmental purposes;

- ability to ensure the manufacturability of products and processes of their manufacture, assessment of the economic efficiency of technological processes for manufacturing biomedical and environmental equipment, as well as biotechnical systems in other areas;

- right to author's support of developed devices, devices, systems and complexes at the design and production stages;

4 Working curriculum of the educational program

4.1. Duration of training 1,5 year

MODULAR CURRICULUM

Education program 7M07132 - *Biomedical engineering*

Form of study: *full*

Duration of training: *1,5 years*

Academic degree: *Master of Technical and Technological*

The cycle	Code	Name of disciplines	Semester	Acad. credits	lec.	lab.	Tutorial	IWD	Type of Final assessment	Department
Profile training module (18 credits)										
Mandatory disciplines										
BD 1.2.1	LNG209	Foreign language (professional)	1	6	0	0	2	2	Exam	EL
BD 1.2.2	MNG274	Management	1	6	2	0	1	3	Exam	SD
BD 1.2.4	HUM204	Management psychology	2	4	1	0	1	2	Exam	SECPM
Module of robotic systems (22 credits)										
Elective disciplines										
BD 1.2.2	ROB258	Control in biotechnical and medical systems	1	6	1	0	1	2	Exam	RaETA
BD 1.2.2.1	ROB256	The dynamics of robots	1	6	1	0	1	2	Exam	RaETA
BD 1.2.3	ROB255	Biotechnical systems	1	4	1	0	1	2	Exam	RaETA
BD 1.2.3.1	ROB254	Information devices of robots	1	4	1	0	1	2	Exam	RaETA
PS 1.3.4	ROB248	Verification, safety and reliability of medical equipment	2	6	2	0	1	3	Exam	RaETA
PS 1.3.4.1	ROB235	Digital processing of measurement information	2	6	2	0	1	3	Exam	RaETA
PS 1.3.6	ROB252	Automated design of medical equipment	2	6	2	0	1	3	Exam	RaETA
PS 1.3.6.1	ROB233	Robot Navigation Systems	2	6	2	0	1	3	Exam	RaETA
Module for planning and designing robotic systems (30 credits)										
Elective disciplines										
PS 1.3.1	ROB245	Computer technologies in biomedical research	1	6	2	0	1	3	Exam	RaETA
PS 1.3.1.1	ROB234	Mathematical modeling and optimization of motion of multi-tier systems	1	6	2	0	1	3	Exam	RaETA
PS 1.3.2	ROB246	Quality management of medical equipment service	1	6	2	0	1	3	Exam	RaETA
PS 1.3.2.1	ROB236	Multi-agent robotic systems	1	6	2	0	1	3	Exam	RaETA
PS 1.3.3	ROB243	Biomedical measuring information systems	2	6	2	0	1	3	Exam	RaETA
PS 1.3.3.1	ROB251	Organization and planning of production of mechatronic equipment	2	6	2	0	1	3	Exam	RaETA
PS 1.3.5	ROB247	Organization and planning of the production of medical equipment	2	6	2	0	1	3	Exam	RaETA
PS 1.3.5.1	ROB202	Diagnostics and reliability of technical systems and devices	2	6	2	0	1	3	Exam	RaETA
PS 1.3.7	ROB241	Clinical, laboratory and environmental analytical equipment	2	6	2	0	1	3	Exam	RaETA

PS 1.3.7.1	ROB238	Designing special purpose robotic systems	2	6	2	0	1	3	Exam	RaETA
Practice-oriented module (10 credits)										
PS 2.3.1	AAP246	Work placement	3	10					Report	RaETA
Experimental research module (18 credits)										
MSERW	AAP247	Master's student experimental research work, including internship and master's project implementation	2	4					Report	RaETA
MSERW	AAP245	Master's student experimental research work, including internship and master's project implementation	3	14					Report	RaETA
Module of final attestation (12 credits)										
FA	ECA205	Registration and defense of the master's thesis	4	12					Defense of dissertation	RaETA
Total			101							

5 Descriptors of the level and scope of knowledge, skills, skills and competencies

The requirements for the master's degree level are determined on the basis of the Dublin descriptors of the second level of higher education (master's degree) and reflect the mastered competencies expressed in the achieved learning results.

Learning outcomes are formulated at the level of the entire master's degree program, as well as at the level of individual modules or academic disciplines.

Descriptors reflect learning outcomes that characterize the student's abilities:

- 1) demonstrate developing knowledge and understanding in the field of biomedical engineering under study, based on advanced knowledge of this field of biomedical engineering, when developing and / or applying ideas in the context of research;
- 2) apply their professional knowledge, understanding and abilities to solve problems in a new environment, in a broader interdisciplinary context;
- 3) collect and interpret information to form judgments, taking into account social, ethical and scientific considerations;
- 4) clearly and unambiguously communicate information, ideas, conclusions, problems and solutions to both specialists and non-specialists;
- 5) training skills necessary for independent continuation of further training in the field of biomedical engineering under study.

6 Competencies for completing training

Universal, social and ethical competencies (USEC)

U-1	Ability to communicate orally and in writing in the state, Russian and foreign languages to solve problems of interpersonal and intercultural interaction
U-2	The ability to assess the surrounding reality based on worldview positions formed by knowledge of the basics of philosophy, which provide scientific understanding and study of the natural and social world by methods of scientific and philosophical knowledge

U-3	Develop an environment that welcomes and supports people from different cultures, and create an atmosphere of striving for knowledge, academic integration, and intellectual motivation
U-4	Have the skills of social design and methods of forming and maintaining the socio-psychological climate in the organization
U-5	Ability to critically use the methods of modern science in practice
U-6	Awareness of the need and ability to learn and improve their skills independently throughout their working life
Special and managerial competencies (SMS)	
S-1	Independently manage and control the processes of work and training activities within the framework of the strategy, policy and goals of the organization, discuss problems, argue conclusions and correctly operate with information
S-2	Organize the activities of the production team, make organizational and managerial decisions in the context of different opinions and evaluate the consequences of decisions
S-3	Organize work in the division to improve, modernize, and unify manufactured biomedical products
S-4	Readiness to lead and participate in the preparation of a feasibility study for projects to create biomedical systems, their subsystems and individual modules
S-5	Ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities
Professional competencies (PC)	
PC-1	Ability to analyze literature data and, based on the analysis, be able to identify and experimentally implement possible ways to improve biomedical systems
PC-2	Ability to conduct professional written and oral communication with all stakeholders in the field of biomedical engineering
PC-3	The ability to demonstrate a sustained interest in self-study and training of both wards and colleagues, to guide and advise them throughout the entire period of professional activity
PC-4	Ability to demonstrate a high level of professional activity while solving industrial and / or scientific tasks, observing all the principles of legal and ethical standards
PC-5	Ability to conduct independent research in biomedical engineering and modernize existing biomedical systems, introduce new methods of digital signal processing with elements of artificial intelligence
PC-6	Ability to design modern and reliable blocks and devices, intelligently controlled Executive, information-sensor and navigation modules of biomedical devices and devices
PC-7	Ability to apply modern software products and the latest technologies to solve and manage interdisciplinary engineering problems in various fields of science and technology
Developed:	
Reviewed: meeting of the AC Institute	Approved by :EMC of SU
Page 3 of 26	

8 Short description of courses

Foreign language (professional)

CODE-LNG205

CREDIT – 5

PRECONDITION – Academic English, Business English, IELTS 5.0-5.5

PURPOSE AND OBJECTIVES OF THE COURSE

Thanks to this course, you will master specific terminology, be able to read specialized literature, and gain the knowledge necessary to carry out effective oral and written communications in a foreign language in your professional activity.

BRIEF DESCRIPTION OF THE COURSE

In the course of training, students acquire knowledge of a foreign language, including the possession of specialized vocabulary, necessary for effective oral and written communications in a foreign language in their professional activities. Practical tasks and methods for developing the required language skills in the learning process include: case studies and role-playing games, dialogues, discussions, presentations, listening tasks, working in pairs or in groups, performing various written tasks, grammar tasks and explanations.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of mastering the discipline, the student will expand the professional lexical vocabulary, possess the skills of effective communication in a professional environment, the ability to correctly Express thoughts in oral and written speech, understand specific terminology and read specialized literature.

Project management

CODE-MNG230

CREDIT – 3

PREREQUISITE - the discipline "Project Management" is based on the knowledge obtained as a result of studying the disciplines of the bachelor's degree

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of teaching the discipline "Project Management" is to master the methodology of project management in various areas of activity, foster a culture adequate to modern project management and information technology, create conditions for the introduction of new information technologies in the field of project implementation. The course is based on the international recommendations on project Management Body of Knowledge.

BRIEF DESCRIPTION OF THE COURSE The content of the discipline is aimed at studying modern concepts, methods, tools of project management in order to apply them in the further practical activities of a specialist to solve the problems of planning and executing projects.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

umet:

- prepare project initialization stage documents, τ, such as feasibility studies, project Charter, etc.
- develop and analyze documents related to project planning, apply various methods of decision support;
- quickly monitor the execution of works and track deadlines;
- select personnel, resolve conflicts between team members;
- manage risks arising from project implementation.

3knowledge obtained during the course of the discipline:

- Modern standards in the project management oblatsi and their characteristics;
- PMI's approach to project management;
- Planning of investment activity;
- Accounting for project risks;
- Methods for optimizing the use of available resources;
- Ways to resolve conflict situations;
- Analysis of actual indicators for timely correction of the progress of work.

navici:

- managing projects in accordance with modern requirements of project management-use MS Project software in the project management process.

Biotechnical Systems
 CODE-ROB255
 CREDIT – 4
 PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

The main goal of the course is to form theoretical and practical knowledge about the modern level of electronic materials science; to form knowledge, skills, skills and competencies on control systems of biotechnical systems; to form a belief about the need for the development of automatic biotechnical systems to ensure human life; to use information tools necessary for future professional activities.

BRIEF DESCRIPTION OF THE COURSE

The discipline "Biotechnical systems" is devoted to the study of methods and techniques of analysis and creation of biotechnical systems and technologies. The processes of interaction between the biological and technical parts of such systems are considered in detail. The objectives of the discipline are to show the possibility of applying biotechnical systems and technologies in various fields of biology and medicine.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of mastering the discipline, the master's student must:

know:

- basic concepts and principles of classification of biotechnical systems and technologies, methods of interaction of various biological and technical links in a single control loop, the main properties and features of biotechnical systems;
- classification of biotechnical systems, purpose, composition and operation principles of the main types of medical devices, devices, systems and complexes, their main technical characteristics;
- features of displaying information about the state of the body and parameters of impacts as a part of biotechnical systems, the main current trends in the development of biotechnical technologies;

be able to:

- apply principles and methods of building models, methods of analysis, synthesis and optimization in the creation and research of biotechnical systems;
- formulate initial data for the selection of biotechnical systems, taking into account the physiological characteristics of research objects and specific medical and biological tasks;
- apply system principles based on examples of functioning of biotechnical devices and systems in interaction with biological subsystems of the body;

own:

- principles and methods of modeling, analysis, synthesis and optimization of biotechnical systems;
- skills of working with modern hardware and software for designing biotechnical systems;
- General ideas about the main technological processes of servicing complex medical equipment.

Developed:	Reviewed: meeting of the AC Institute	Approved by :EMC of SU	Page 3 of 26
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Medical information system
 CODE-ROB253
 CREDIT – 4
 PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

The main purpose of the course -The main purpose of this course is to study the ability of modern organizations to use the achievements of modern management theory and practice. The course is aimed at developing effective management skills and the ability to make informed managerial decisions in the field of managing healthcare organizations.

Course objectives:

The main tasks are:

1. Study of the main functions and principles of modern management practices of healthcare institutions;
2. Development of skills to assess the external and internal environment of the organization, using modern methods of diagnostics of healthcare organizations;
3. Development of communication and interpersonal skills in the business environment;

BRIEF DESCRIPTION OF THE COURSE

Fundamentals of service management and the service sector: The revolution of services and the change of managerial paradigms. Management paradigms and paradigm shifts. Service orientation and new configuration of modern organizations: network relations and virtual corporations. The essence and content of service sector management. Social problems of management in healthcare. Service infrastructure.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

1. Must know: the essence and significance of information in the development of a modern information society, comply with the basic requirements of information security; know and take into account the main psychological characteristics of the consumer of health services;
2. Must be able to: carry out activities related to the management or actions of individual employees; plan production and economic activities of a medical institution depending on changes in the market for educational services and consumer demand;
3. Must possess: basic methods, methods and means of obtaining, storing, processing information, have computer skills as a means of information management; work with information in global computer networks;

Biomedical Measurement Information Systems
 CODE-ROB243
 CREDIT – 4
 PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

The main purpose of the course: obtaining new knowledge through the development of fundamental and applied scientific research in the field of biomedical engineering; preparing for research activities, the objects of which are devices, systems and complexes of medico-biological purpose, methods and technologies for performing medical, biological, environmental research; automated systems for processing biomedical information; biotechnical control systems.

BRIEF DESCRIPTION OF THE COURSE

Purpose and main functions of measurement information systems. The basic structure blocks of technology of the medical information system. Automatic control systems. Separation of measuring channels and ways to deal with interference. Biomedical signals and their origin. Electrodes for the removal of biomedical signals. Sensors for biomedical signals. Bridge schemes for measuring biomedical signals. Principle of compensation during measurement. Design of information and measuring systems. Metrological characteristics of sensors and measuring devices. Measurement of bioimpedance. Amplifiers of biopotentials. Matching the biopotential sensors with the measuring circuit. Differential amplifiers of biomedical signals. Electrocardiographic amplifiers

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

to understand: the methodology for conducting measurements with a large number of sensors; the principles of organizing synchronization of the transmitting and receiving parts of measuring systems; methods for improving the noise immunity of the AIS.

to perform calculations of parameters of measuring systems; to select and calculate the error of measuring converters; to select normalizing converters, measuring switches; to calculate the error variances of functional units of the measuring system.

to possess: methodology for calculating the parameters of the AIS according to the criterion of minimum total error, which fit into the confidence interval, methodology for performing diagnostic procedures using technical diagnostics systems when searching for a malfunction of complex systems according to the criterion of minimum labor costs.

Clinical laboratory and Environmental Analytical Equipment

CODE-ROB241

CREDIT – 4

PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

The main purpose of the course: formation and improvement of professional competencies of an engineer-specialist of a medical and diagnostic profile to provide a laboratory component of the process of rendering specialized, high-tech, medical and engineering, technical assistance, metrological control of devices and equipment in laboratories.

BRIEF DESCRIPTION OF THE COURSE

Biotechnical systems of laboratory analysis. Structure and functions of laboratory services in medicine and ecology. Optimization methods of technological schemes of laboratory experiments. Information approach to the analysis of the substance. Devices and systems for laboratory analysis on the basis of physical and physico-chemical methods of study of biological substrates took place. Methods based on nuclear magnetic resonance phenomena. Electron microscopy. Hardware methods of immunological research; analytical equipment for laboratories of sanitary and epidemiological stations. Methods of designing analytical and ecological equipment. Measuring converters of laboratory equipment. Tools for displaying results. Designing analytical techniques. Information support for laboratory medical research. Structure of information flows in a clinical laboratory. Survey databases and knowledge bases. Methods for optimizing information flows. Questions of standardization and Metrology in analytical instrumentation. Standards and reference materials, verification schemes and stands.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

A master's student should know:

today's quality control of laboratory studies: the procedure for implementation, evaluation of results. The main issues of planning, management, and material and technical equipment of the laboratory. Principles of selecting and calculating the need for laboratory equipment and reagents. Calculating the cost of a laboratory test. Time limits and expense limits for performing laboratory tests. Principles of evaluating the effectiveness of the laboratory. Financial support of the laboratory's activities.

must be able to:

use modern analytical technologies and equipment; use of information technologies to solve problems of clinical medicine and scientific research.

Quality Management of Medical Equipment Services

CODE-ROB246

CREDIT – 5

PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

Study a model for evaluating the quality of the process for repairing and maintaining medical equipment. Identify the signs of quality assessment in enterprises engaged in the repair and maintenance of medical equipment. Study of the quality management system of processes in the production, commercial and educational spheres»:

Tasks: Principles of product quality management in production. General quality management. Operational quality management in ISO international standards is defined by the term quality management – these are methods and activities of an operational nature used to meet quality requirements. Long-term management of quality and the organization as a whole in ISO international standards is defined by the term universal quality management.

BRIEF DESCRIPTION OF THE COURSE

Система управления A product quality management system is a set of management bodies and management objects, measures, methods and tools aimed at establishing, ensuring and maintaining a high level of product quality. The development of a quality system basically consists of first, taking into account the recommendations of ISO 9000 standards, determining the composition of the necessary functions of the quality system, and then the structures that perform or will perform these functions. After that, new regulatory documents are developed, revised or used to perform all functions.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

3Zn: rules, procedure for conducting maintenance. Nomenclature and procedure for issuing technical documentation. Quality management system of enterprises engaged in the production and maintenance of medical equipment.

yumet: enter into and execute contracts for the maintenance of medical equipment

Organization and Planning of Production of Medical Equipment
CODE-ROB247
CREDIT – 5
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the discipline is to study the interrelation of the most important issues and factors of the science of production organization, ensuring the effective functioning of an industrial enterprise – the primary link of material production.

Discipline objectives:

- master the basics of production organization;
- thoroughly study the organization of production processes;
- learn the basics of organizing production infrastructure and auxiliary workshops that provide services to the enterprise;
- study the organization, planning and management of the preparation and development of new equipment in the enterprise.

BRIEF DESCRIPTION OF THE COURSE

General characteristics of the production process and its structure Principles of organizing production processes. Indicators of the organization of the production process. The concept of organizational type of production and its defining features. Classification and technical and economic characteristics of production types. Technological preparation of production, tasks, content and procedure of its implementation. Selection and optimization of technological solutions. Organizational and economic preparation, its content, tasks and procedure. Determination of the critical program of technological processes by graphical and grapho analytical methods. The organization of scientific-research and experimental-design work. Planning of technical training. Method of network planning charts the sequential, parallel and series-parallel methoding the transition to the new products.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

know: master the basics of production organization; thoroughly study the organization of production processes; study the basics of organizing production infrastructure and auxiliary shops that provide services to the enterprise; study the organization, planning and management of the preparation and development of new equipment at the enterprise.

Verification, Safety and Reliability of Medical Equipment
 CODE-ROB248
 CREDIT – 4
 PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

Formation of knowledge about the operation and maintenance of medical devices, biotechnical systems and apparatuses in the conditions of medical and biological organizations, training in the principles of ensuring safe living conditions in the development, production and operation of biomedical devices, complexes and systems, training in ways to apply methods of organizing routine work, verification and certification of medical equipment.

BRIEF DESCRIPTION OF THE COURSE

Modern approach, problems and trends of ensuring electrical safety in medical institutions (MU). The effect of electric current on the human body. Protection against touching live parts. Leakage current in medical devices. Classification of medical devices (MT) on electrical safety. Rules for installing electrical installations. Electrical equipment of medical institutions. Emergency power supply system of the MU. Protecting an electrically vulnerable patient. Main characteristics and reliability parameters. Methods for improving the reliability of MT. General questions of verification of measuring instruments for medical purposes. Methods of verification of electrocardiographs. Testing of MT. MT service. Maintenance of MT. Troubleshooting and repairing MT.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of mastering the discipline, the master's student must know:

- basic requirements and rules for ensuring the safety and reliable operation of technical equipment in medical institutions of various profiles;
- fundamentals of organization of technical maintenance, service and repair of MT;
- regulatory documentation applicable in the field of safety, reliability, maintenance, service and repair of MT;

be able to:

- ensure safe and reliable operation of the MT in MU;
- carry out verification of measuring devices for medical purposes;
- carry out maintenance and service of MT.

own:

- the skills of repairing MT;
- skills of organizing safe and reliable operation of technical means in MYthe Moscow state UNIVERSITY .
- skills of designing non-standard equipment and fixtures.

Computer Technologies in Medical and Biological research

CODE-ROB245

CREDIT – 5

PRECONDITION – Information and Communication technologies

PURPOSE AND OBJECTIVES OF THE COURSE

The main purpose of the course: to form the necessary information about technical and software tools for medical and biological research, to create algorithms for processing biosignals, ideas about methods and technology for processing physical information received from a biological object, about computer systems as a tool for working with information, about methods for automating the creation and maintenance of software.

Objectives: to establish the role of technical means and computer technology in obtaining, storing, transmitting, or processing data necessary for the implementation of medical technologies, biomedical research; to examine various methods of creating an information-structural models for biomedical research; familiarize with the concept and implementation of databases, studying the systems of decision support and expert systems as the most important tool in the doctor's work, accumulating experience and other professionals; to acquaint with methods and algorithmic support, automate the creation and maintenance of software equipment for biomedical research.

BRIEF DESCRIPTION OF THE COURSE

Automation of research. Development of a medical consultation and diagnostic system using VBA. Examples of practical implementation of computer technologies in medical and biological practice. Development of the graphical interface in the MATLAB package. Computer technology in obtaining, storing, transmitting, and processing data necessary for the implementation of medical technologies. Various methods of constructing information and structural models of biomedical research. Concept and implementation of databases as the main information structure for storing and using data about a biological object. Problems related to data security and protection from unauthorized access. Decision support systems and expert systems as the most important tool in the work of a doctor, accumulating the experience of other specialists; Methods of algorithmic support, automation of the creation and maintenance of software for medical and biological research equipment.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of mastering the discipline, the master's student must:

know:

- features of biological objects;
- the main directions in the practice of using computer technologies in modern medicine; terminology that is used in the measurement of physiological indicators by medical devices and apparatuses, converters of physiological indicators into electrical signals, signal amplification and processing units and basic display tools;

- structural diagrams and basic characteristics of medical devices for various purposes; basics of algorithmization and programming;
- methods and tools the use of computer technology in traditionally well known areas of medical diagnosis and therapy, such as cardiography, encephalography, electromyography, medical analytical equipment, cardiac pacing and electrical stimulation of neuromuscular structures in the relatively new fields of diagnosis and therapy associated with the use of sophisticated medical equipment such as tomography, ultrasound echosono graphy, laser and optoelectronic endoscopy and modern analytical equipment.

be able to:

- use the results of mastering fundamental and applied disciplines of the master's program to select optimal methods and means of conducting research using computer technologies;
- design, present and report the results of the work performed;
- analyze the state of scientific and technical problems by selecting, studying and analyzing literary and patent sources in the field of biotechnical systems and technologies.

own:

- skills of choosing optimal methods and techniques for studying the properties of biological objects and forming research programs;
- skills of using computer technologies for conducting medical and biological research; practical skills of working with packages of applied programs for conducting research in medical and biological practice;
- skills of developing information consulting and diagnostic systems.

Management in Biotechnical and Medical Systems

CODE-ROB

CREDIT – 5

PRECONDITION – physics, chemistry, and mathematics

PURPOSE AND OBJECTIVES OF THE COURSE

Objectives of the discipline: formation of knowledge, skills and competencies in the management of biotechnical systems; formation of a belief about the need for the development of automatic biotechnical systems to ensure human life; the use of information tools necessary for future professional activities.

BRIEF DESCRIPTION OF THE COURSE

The content of the discipline: Basic concepts of automatic control theory. Classification of automatic control systems. Linear automatic control systems. Nonlinear automatic control systems. Optimization of the management strategy. The observability and controllability. Quality criterion. Passive and active control in living systems. Bio-management and biofeedback.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of mastering the discipline "Management in biotechnical and medical systems" students should:

know:

- tasks of controlled medical-biological experiment, solved with the use of modern technical means; principles, technical means and methods of organizing a medical-biological experiment; methods of organizing the collection, processing of medical-biological information, control and management of the experiment; technical and software systems for automating biomedical research in physiological, biophysical and neurophysiological experiments;

be able to:

- use the obtained knowledge in organizing a medical experiment using technical means; effectively organize the processing and presentation of experimental data;

own:

- skills of using standard devices and research automation programs in controlled medical and biological experiments.

Computer-aided Design of Medical Equipment

CODE-ROB252

CREDIT – 4

PRECONDITION – Integrated and Microprocessor Circuitry

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of teaching the discipline is to study the methodology of modern methods of designing medical equipment. The goal is to systematize, consolidate and deepen theoretical knowledge and skills, apply this knowledge at the stage of technical design, develop skills for conducting independent work, conduct theoretical and experimental research using means and methods of microprocessor technology.

BRIEF DESCRIPTION OF THE COURSE Creation of tools for diagnostics, treatment, rehabilitation and prevention of human diseases intended for use in diagnostic and therapeutic medical centers, hospitals, outpatient clinics, and polyclinics. Development of automation tools for medical and biological systems. Development of software for solving practical problems of medicine, including the problems indicated above. Development of structural and functional diagrams of radio engineering systems and complexes and schematic diagrams of the device using computer-aided design. Modeling of objects and processes in order to analyze and optimize their parameters using available research tools, including standard application software packages.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of studying the discipline, a master's student must:

know:

developed tools for metrological support of diagnostics and repair of biomedical equipment; design and manufacture of equipment; be

able to:

to take part in commissioning, testing and commissioning of prototypes of devices and systems; to build mathematical models of objects and processes, choose their research methods and to develop an algorithm for its implementation; to review the state of scientific and technical problems on the basis of selection and study of literature and patent sources;

to possess:

programs for the implementation of experimental studies, including the choice of technical equipment and processing of results.

Preparation and defense of a master's thesis

CODE-ECA501

CREDIT-12

The purpose of the master's thesis is to demonstrate the level of scientific/research qualifications of the master's student, the ability to independently conduct scientific research, test the ability to solve specific scientific and practical problems, knowledge of the most General methods and techniques for solving them.

BRIEF DESCRIPTION

Master thesis – graduation qualification scientific work, which is a generalization of the results of independent studies undergraduates one of the pressing problems of a particular specialty relevant branch of science that has internal unity and reflects the progress and results of the development of the chosen topic.

Master's thesis-the result of research /experimental research work of a master's student, conducted during the entire period of study of a master's student.

Master's thesis defense is the final stage of master's degree preparation. The master's thesis must meet the following requirements:

- the work should conduct research or solve current problems in the field of biomedical engineering;
- the work should be based on identifying important scientific problems and solving them;
- decisions must be scientifically sound and reliable, and have internal unity;
- the dissertation work must be written individually.

CONTENT

- 1 Scope and content of the program
- 2 Requirements for applicants
- 3 Requirements for completing studies and obtaining a diploma
- 4 Working curriculum of the educational program
- 5 Descriptors of the level and scope of knowledge, skills, and competencies
- 6 Competencies at the end of training
- 7 Annex to the certificate according to the standard ECTS
- 8 Brief description of courses

РЕЦЕНЗИЯ
на образовательную программу
«7M07136 Биомедицинская инженерия»

Содержание образовательной программы магистратуры разработано на основе принципов непрерывности и преемственности с предыдущим уровнем образования - бакалавриат. Все дисциплины являются логическим продолжением дисциплин бакалавриата, их содержание носит более углубленный характер.

Продолжительность освоения образовательной программы магистратуры составляет 1,5 года.

Образовательная программа построена таким образом, чтобы обеспечивалась целостность образования, сочетание фундаментальной подготовки с междисциплинарным характером профессиональной деятельности специалиста и полностью соответствует требованиям Типового учебного плана по специальности высшего образования. Содержание и объем учебных курсов по базовым дисциплинам являются достаточными для последующего изучения профилирующих дисциплин. Структура образовательной программы основана на модульном принципе, при составлении которой соблюдается комплексный подход.

Образовательная программа специальности нацелена на достижение определенного образовательного результата, от фундаментальных и общих профессиональных до специальных узко прикладных. Виды профессиональных практик, диссертационные работы включаются в соответствующие модули образовательной программы в зависимости от взаимосвязи и единства целей с учебными дисциплинами.

Программа обеспечивает изучение и исследование всех видов современных информационно-измерительных систем и комплексов.

Программа обеспечивает магистрантам возможность проходить стажировку за рубежом и проводить различные исследовательские работы. Развивает у магистрантов способности к пониманию современных достижений в области проблем развития приборостроения.

Директор ТОО «MedRemZavod Holding»



Джумагулов А.К.