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Report on the development of competencies related to the specialization developed within the framework of the BIOART project (Innovative Multidisciplinary Curriculum in Artificial Implants for Bio-Engineering BSc / MSc Degrees)

The concepts of IT development in the field of medicine

To know the basic concepts of the development of medical technologies related to the acquisition, transmission and processing of information for various purposes, including nanomedicine, orthopedics, stimulation, diagnostics and the use of implants.

To master the terminology and solve the applied problems in the field of application of information technologies in medicine.

The ability to solve standard tasks of professional activity on the basis of information and bibliographic culture with the use of information and communication technologies and taking into account the basic requirements of information security, ethical and legal aspects of the use of medical information.

Sensors. Wireless sensor networks. Bio-sensors. Simulation and design of MEMS and NEMS sensors

To know the types and understand the features of the application of medical sensors (sensors), topologies and characteristics of the wireless sensor network.

To master the principles of operation and the scope of application of biosensors, converters, their features and limitations, various components of biosensors and the biosensor network.

To master the principles of designing and modeling biosensor networks, to know the features of the bioelectronic components used, potential advantages and achievements in creating wireless sensor networks.

To master the choice of types and methods of application of various types of intelligent sensors and sensory systems to obtain the patient's condition and to provide interpretation of the readings received from sensors and sensor networks during diagnostics.

Medical equipment.

To know the definition of the terms of equipment of biomedical systems, trends and problems in their design, own software for the automated development of biomedical equipment.

To master and apply methods of mathematical modeling of biomedical equipment, to create mathematical models that describe the work of biomedical equipment and software for modeling.

To perform fault diagnosis, master the methods of monitoring and testing of biomedical equipment.

To be competent in creating a software for calculating the reliability of biomedical equipment.

To know the methods, categories and types of standardization of biomedical equipment, be able to use the standards for biomedical equipment and formulate requirements for it.

To understand the basic concepts in the field of nano- and microelectromechanical systems of the possibility of their application in medicine, to master their structure and device, as well as the principles of computer-aided design and use.

Design. Biomedical System Development Hardware:

Advanced ECAD. Embedded Systems

To perform a development of medical systems by using measurements of various parameters of human subsystems.

To know the basic concepts, stages and technologies of design, manufacture and control of printed circuit boards.

To carry out the selection of the necessary electronic components for the project, own practical methods of designing printed circuit boards.

The use of automated means of designing electronic circuits, printed circuit boards.

Mechanical: Advanced MCAD / MCAM

To have computer simulation skills in the design of biomedical equipment and implants, in accordance with the individual anatomical features of a person, to use for this system of automated design.

To design and implement software for the creation and manufacture of hardware and implant components in MCAD / MCAM packages, to work with 3D printers and to integrate with these systems.

Signal processing technologies. Biomedical digital signal processing (DSP). Statistical signal processing

To understand fundamental concepts of processing digital signals and to master the use of digital filters for converting signals.

To possess skills of testing, data collection and processing of digital signals of biomedical purposes, to apply various methods of transformation and analysis of signals in computerized medical systems.

To master the methods of simulation and statistical processing of signals

Communication Digital Communications. Telemedicine Smart sensors and sensor networks. Diagnostic and therapeutical devices.

To perform operations related with the digitization and information transmission, to perform mathematical modeling in the field of digital communications.

To apply signal processing techniques, images and video to patient diagnosis and monitoring, including the use of microcontrollers and wireless network technologies for remote diagnostics and monitoring.

To understand the principles of data transmission, know the types and routing protocols, master the design and development of new network architectures and MAC protocols.

The application of various types of network infrastructure creation in telemedicine for the transfer of images, video and remote interaction of equipment in biomedical diagnostic systems.

The ability to solve patient safety issues when receiving and transmitting information, including protection from electromagnetic radiation using wireless network technologies.

Mathematical modeling. Machine learning and artificial intelligence Intelligent devices

To be able to implement a mathematical representation of models of different types of systems, to perform iterative development of the model; the use of models and the modeling process to test hypotheses, assess the adequacy of models.

The ability to master modern technologies of mathematical modeling of objects, processes and phenomena, to develop computational models and algorithms of numerical solution of problems of mathematical modeling taking into account the errors of the approximate numerical solution of professional problems.

The ability to carry out a formal description of the tasks of research operations in organizational, technical and socioeconomic systems of different purposes; to determine their optimal solutions by using methods of machine learning and artificial intelligence.

The ability to perform an intelligent multidimensional analysis of data and their operational analytical processing with visualization of the results of analysis in the process of solving applied problems in the field of computer sciences.

To create mathematical models and algorithms on the basis of which research knowledge in databases and data repositories (knowledge discovery in database - KDD) is conducted, including knowledge acquisition (Data Mining).

To develop information models of medical diagnostic process in health care institutions; to evaluate the effectiveness of the system of receiving, collecting, processing, transmitting and protecting medical information.

To master the documentation of the development and the implementation of the models and its presentation in oral and written form.

Biomaterials. Biomechanics. Biomaterials. Biomechanics.

To master the topographic anatomy of a person, to own means of modeling kinematics and dynamics of the motor apparatus of man.

To understand the requirements for biomedical materials and products from them, to the physico-mechanical properties of biomedical materials and master the methods for their determination and statistical processing.

To have a basic understanding about bioinerticity (biocompatibility), electroneutrality, nontoxicity, tribological characteristics of the stress-strain and fatigue of materials used for implants.

To formulate tasks and perform strength calculations by using SAE systems, taking into account mathematical models of behavior of biomedical materials.

The developed set of competences is not a mandatory for full application. This set of competences can be reduced or expanded depending on the competencies of the basic specialty and profile of the institution.

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НАЦІОНАЛЬНА АКАДЕМІЯ МЕДИЧНИХ НАУК УКРАЇНИ
ДЕРЖАВНА УСТАНОВА ІНСТИТУТ ПАТОЛОГІЇ ХРЕБТА ТА СУГЛОБІВ ІМЕНІ ПРОФЕСОРА М.І.СИТЕНКА НАЦІОНАЛЬНОЇ АКАДЕМІЇ МЕДИЧНИХ НАУК УКРАЇНИ"
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