Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation

APPROVED
Vice-Rector for Academic Affairs
_____ E.S. Bogomolova
31 August 2021

WORKING PROGRAM

Name of the academic discipline: **BIOINFORMATICS IN MEDICINE (elective)**

Specialty: **31.05.01 GENERAL MEDICINE**

Qualification: **GENERAL PRACTITIONER**

Department: **MEDICAL BIOPHYSICS**

Mode of study: **FULL-TIME**

Labor intensity of the academic discipline: **72 academic hours**

Nizhny Novgorod
2021

The working program has been developed in accordance with the Federal State Educational Standard for specialty 31.05.01 GENERAL MEDICINE approved by Order of the Ministry of Science and Higher Education of the Russian Federation No. 988 of August 12, 2020.

Developers of the working program:

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The program was reviewed and approved at the department meeting of the Department of Medical Biophysics (protocol No. 9, *April 15, 2021*)

Head of the Department of Medical Biophysics,
Ph.D. (Physical and Mathematical Sciences), Ph.D. (Biology),
Professor _____ D.I. Iydin
(signature)

April 15, 2021

AGREED
Deputy Head of EMA ph.d. of biology _____ Lovtsova L.V.
(signature)

April 15, 2021

1. The purpose and objectives of mastering the academic discipline «Bioinformatics in medicine» (hereinafter – the discipline):

1.1. **The purpose of mastering the discipline:** participation in the formation of UC-1 competencies consists in the formation of students' ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy.

1.2. **Tasks of the discipline:**

- formation of logical thinking among students of the medical faculty, the ability to accurately formulate a task, the ability to isolate the main and secondary, the ability to draw conclusions based on the obtained measurement results;
- to train students with medical education in bioinformatics methods and give an idea of the relationship between computational and experimental medicine and biology;
- to use newest information technologies in solving the tasks of professional activity, observing the requirements of information safety;
- to study the basics of research in bioinformatics, the methodological base of bioinformatics, system computer biology and information technologies used in bioinformatics.

1.3. **Requirements to the deliverables of mastering the discipline**

As a result of completing the discipline, the student should

Know:

- basic terms and concepts of bioinformatics, modern concepts of bioinformatics;
- objects of bioinformatics study;
- methods of investigation of biomedical sequences, their descriptions, prediction of structure and functions;
- technical and software tools for the implementation of information technologies;
- basics of working in local and global networks; features, capabilities and limitations of specialized databases and the specifics of working with them.

Be able to:

- to identify objective, physical processes in biological systems and determine their relationship with the fundamental laws of physics;
- use analog and digital measuring instruments to measure the mechanical properties of liquids, electrical and optical characteristics of biological objects, dosimetry;
- to evaluate the resolution and resolution limit of an optical microscope, to characterize the properties of images obtained in a lens, eyepiece, microscope, to find instrument errors of analog and digital measuring instruments;
- to carry out statistical processing of the results of laboratory measurements of physical quantities, to evaluate confidence intervals according to a given confidence probability, mode, median of the sample, to build histograms and cumulative distributions, to evaluate the errors of direct and indirect measurements of physical quantities, to carry out measurements using digital devices.

Possess:

- to find, analyze, summarize and systematize scientific data obtained during biological, chemical and physical experiments in order to set research goals and choose optimal ways and methods to achieve them;
- to select the necessary and optimal conditions for scientific analysis, depending on the specifics of the task with the use of bioinformatics methods;
- use standard and specialized packages of applied computer programs to solve practical problems of bioinformatics.

2. Position of the academic discipline in the structure of the General Educational Program of Higher Education (GEP HE) of the organization.

2.1. The discipline «Bioinformatics in medicine» refers to the core part of Block 1 (B1.PEP.E1) of GEP HE. The discipline is taught in 3 semester/2year of study.

2.2. The following knowledge, skills and abilities formed by previous academic disciplines are required for mastering the discipline:

- physics;
- mathematics;
- biology, fundamentals of genetic and cellular engineering;
- medical informatics;
- chemistry;
- biological chemistry.

2.3. Mastering the discipline is required for forming the following knowledge, skills and abilities for subsequent academic disciplines: physiology, biochemistry, microbiology and virology, hygiene, public health, radiation diagnostics and radiation therapy.

3. Deliverables of mastering the academic discipline and metrics of competence acquisition

Mastering the discipline aims at acquiring the following universal (UC) or/and general professional (GPC) or/and professional (PC) competencies

№	Compe-tence code	The content of the competence (or its part)	Code and name of the competence acquisition metric	As a result of mastering the discipline, the students should:		
				know	be able to	possess
1.	UC-1	Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy	*ID-1* *CC-1.1.* Knows: methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis *ID-2* *CC-1.2.* Able to: gain new knowledge based on analysis, synthesis, etc.; collect data on complex scientific problems related to the professional field; search for information and solutions based on action, experiment and experience	methods of systematic and critical analysis; methods of developing action strategies for identifying and solving a problem situation	apply the methods of a systematic approach and critical analysis of problem situations; develop a strategy of actions, make concrete decisions for its implementa-tion	methodology of systematic and critical analysis of problem situations; methodology of goal setting, determination of ways to achieve it, development of action strategies.

** Competence achievement indicator – a set of planned learning outcomes in disciplines (modules) and practices that ensure the formation of all graduate competencies established by the specialty program.*

These are generalized characteristics that clarify and reveal the formulation of competence in the form of specific actions performed by a graduate who has mastered this competence. Indicators should be comparable to labor functions and/or labor actions (professional standard), but not equal to them. Indicators of competence achievement should be measured using the means available in the educational process.

4. Sections of the academic discipline and competencies that are formed when mastering them:

№ p/p	Compe-tence code	Section name disciplines	The content of the section in didactic units
1.	UK-1	Introduction to Bioinformatics. Basic concepts of mathematical statistics in biology and medicine.	Bioinformatics as a science. Cybernetics, its history and connection with bioinformatics. The development of bioinformatics in our time. The subject of the study of bioinformatics. Connection with other biological sciences. The use of bioinformatics in biology and medicine.
2.	UK-1	Applied sciences - basic concepts and methods	Genomics, basic presentation, modern methods of genomics: PCR, genotyping, SNP, SAGE, NGS Proteomics, basic presentation, modern methods of proteomics: 2D-PAGE electrophoresis, Western blotting, mass spectrometry Metabolomics, and its main method is mass spectrometry Transcriptomics
3.	UK-1	Proteomics	Proteins: structure, functions, methods of analysis and determination of proteins. Software and databases: BLAST - Basic Local Alignment Search Tool is a family of computer programs used to search for homologues of proteins or nucleic acids for which the primary structure (sequence) or its fragment is known. UniProt is a database of protein sequences. HMMER - used to search databases for sequence homologues and to align amino acid sequences. Implements methods using probabilistic models called profile hidden Markov models. Expression Atlas is a database that provides information about gene expression patterns.
4.	UK-1	Protein modifications and methods of their study	Molecular research methods: Western blotting, electrophoresis, immunochemistry, mass spectrometry. PRIDE - PRoteomics IDEntifications is a centralized, standards-compliant repository of publicly available data for proteomics data, including protein and peptide identification, post-translational modifications, and spectral data support. The workshop. Mascot (Matrix Science) - Software for the identification, characterization and quantification of proteins using mass spectrometry data.
5.	UK-1	Protein structure prediction and calculation capabilities	Protein–to-protein and intermolecular interactions are a biological role. InterAct - IntAct Molecular Interaction Database - is a freely available open source database system and tools for analyzing molecular interaction data. All interactions are based on literary curation or direct user submissions and are freely available. Reactome is an open source, curated and peer-reviewed signaling path database. BioGRID - The Biological General Repository for Interaction Datasets is a curated biological database of protein-protein interactions, genetic interactions, chemical interactions and post-translational modifications.
6.	UK-1	Mathematical modeling – basic concepts.	Types of mathematical models used in medicine and biology. Modeling in proteomics. BioModels is a free, open source repository for storing, sharing and retrieving quantitative models of biological interest.
7.	UK-1	Metabolomics	MetabolLights is a data repository for interspecific and cross-platform metabolomic studies and a knowledge base on the properties of individual metabolites. Transcriptomics as a science, its significance for modern medicine. Signaling pathways and networks of intermolecular interactions. Cytoscape - Network Data Integration, Analysis, and Visualization in a Box is an open source bioinformatics platform designed to visualize networks of molecular interactions and biological pathways with the possibility of using additional data, such as functional annotation, information about the level of expression.

5. Volume of the academic discipline and types of academic work

Type of educational work	Labor intensity		Labor intensity (AH) in semesters
	volume in credit units (CU)	volume in academic hours (AH)	3
Classroom work, including	1,2	44	44
Lectures (L)	0,3	10	10
Laboratory workshops (LP)*	***FSES are not provided***		
Practicals (P)	0,9	34	34
Clinical practical training (KPZ)	***FSES are not provided***		
Seminars (S)	***FSES are not provided***		
Student's individual work (SIW)	0,8	28	28
Mid-term assessment			
CREDIT			
TOTAL LABOR INTENSITY	**2**	**72**	**72**

6. Content of the academic discipline

6.1. Sections of the discipline and types of academic work

№	Semester No.	Name of the section of the academic discipline	Types of academic work* (in AH)					
			L	LP	P	S	SIW	total
1.	3.	Introduction to Bioinformatics.	1		3		4	8
2.	3.	Applied sciences - basic concepts and methods.	1		3		4	8
3.	3.	Proteomics.	1		6		4	11
4.	3.	Protein modifications and methods of their study.	1		6		4	11
5.	3.	Protein structure prediction and calculation capabilities	2		6		4	12
6.	3.	Mathematical modeling – basic concepts.	2		6		4	12
7.	3.	Metabolomics	2		4		4	10
		CREDIT						
		TOTAL	***10***		***34***		***28***	***72***

* - L – lectures; LP – laboratory practicum; P – practicals; S – seminars; SIW – student's individual work.

6.2. Thematic schedule of educational work types:

6.2.1. Thematic schedule of lectures

№	Name of lecture topics	Volume in AH
		Semester 3
1.	Introduction to Bioinformatics. Bioinformatics as a science. Cybernetics, its history and connection with bioinformatics. The development of bioinformatics in our time. The subject of the study of bioinformatics. Connection with other biological sciences. The use of bioinformatics in biology and medicine.	1
2.	Applied sciences. Basic concepts and methods: genomics, basic presentation, modern genomics methods: PCR, genotyping, SNP, SAGE, NGS	1
3.	Proteomics. Basic presentation, modern methods of proteomics: 2D-PAGE electrophoresis, Western blotting, mass spectrometry. Proteins: structure, functions, methods of analysis and determination of proteins.	1
4.	Metabolomics. The main method is mass spectrometry. Basic concepts of transcriptomics	1
5.	Protein modifications and methods of their study. Molecular research methods: Western blotting, electrophoresis, immunochemistry, mass spectrometry	2
6.	Protein structure prediction and calculation capabilities. Modern research methods. Protein–to-protein and intermolecular interactions are a biological role.	2
7.	Mathematical modeling. Basic concepts. Types of mathematical models used in medicine and biology. Modeling in proteomics.	2
	TOTAL (total - AH)	***10***

6.2.2. The thematic plan of laboratory practicums
- FSES are not provided.

6.2.3. Thematic plan of practicals

№	***Name of laboratory practicums***	Volume in AH
		Semester 3
1	CS"Statistica" - a workshop on the use of. BLAST - Basic Local Alignment Search Tool — Basic Local Alignment search tool)	3
2	UniProt is a database of protein sequences. HMMER for searching databases for homologues of amino acid sequences. Expression Atlas.	6
3	PRIDE - PRoteomics IDEntifications. Mascot (Matrix Science) - Software for identification, characterization and quantification of proteins using mass spectrometry data	9
4	InterAct - IntAct Molecular Interaction Database. Reactome is an open source, curated and peer-reviewed signaling path database. BioGRID - The Biological General Repository for Interaction Datasets - supervised biological database of protein-protein interactions	6
5	BioModels is a free, open source repository for storing, sharing and retrieving quantitative models of biological interest	6
6	MetabolLights is a data warehouse for interspecific and cross-platform metabolomic studies. Cytoscape - Network Data Integration, Analysis, and Visualization in a Box – Open source bioinformatics platform	4
	TOTAL (total - AH)	***34***

6.2.4. Thematic plan of seminars

- FSES are not provided.

6.2.5. Types and topics of student's individual work (SIW)

№ п/п	***Types and topics of SIW***	Volume in AH
		semester 3
1	Preparation for practical classes, homework; preparation for the current control. *HW, DEW*	10
2	Working with lecture material. *HW, DEW*	6
3	Work with electronic educational resources posted on the educational portal of the University, distance education website.	4
4	Study of the material of independent work corresponding to the studied section of the discipline (separate topics, paragraphs), work with literary sources *HW, DEW*	6
5	Preparation for testing, *on-line* testing. *HW, DEW*	2
	TOTAL (total – AH)	***28***

***Types of independent work: work with literary and other sources of information on the section under study, including in an interactive form, homework (HW), work with electronic educational resources posted on the educational portal of the University, distance education website (DEW), etc.*

6.2.6. Student's research work

- FSES are not provided.

7. Types of assessment formats for ongoing monitoring and mid-term assessment

№	Semester No.	Types of control		Name of section of academic discipline	Competence codes	Assessment formats		
						types	number of test questions	number of test task options
1.	3	Current monitoring	Control of mastering the topic	Introduction to Bioinformatics	UC-1	Test	30	20 - Computer testing (the variant is formed by random sampling)
						Testing of practical skills.	3	20
						Interview	2	50
			Monitoring the student's individual work			Writing a test paper (or preparing an audio report)	8	45
2.	3	Current monitoring	Control of mastering the topic	Applied sciences - basic concepts and methods	UC-1	Test tasks. Oral individual survey.	30	20 - Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12

						Current testing. Oral individual survey.	20	50
			Monito-ring the student's individual work			Writing a report on an individual task (or preparing an audio report).	20	12
3.	3	Current monito-ring	Control of mastering the topic	Proteomics	UC-1	Test tasks. Oral individual survey.	30	20 - Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
						Current testing. Oral individual survey.	20	30
			Monito-ring the student's individual work			Writing a report on an individual task (or preparing an audio report).	20	12
4.	3	Current monito-ring	Control of mastering the topic	Protein modifica-tions and methods of their study	UC-1	Test tasks. Oral individual survey.	20	20 - Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
						Current testing. Oral individual survey.	20	30
			Monito-ring the student's individual work			Writing a report on an individual task (or preparing an audio report).	20	12
5.	3	Current monito-ring	Control of mastering the topic	Protein structure prediction and calculation capabilities	UC-1	Test tasks. Oral individual survey.	30	Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
						Current testing. Oral individual survey.	20	20
			Monito-ring the student's individual work			Writing a report on an individual task (or preparing an audio report).	20	12
6.	3	Current monito-ring	Control of mastering the topic	Mathemati-cal modeling – basic concepts.	UC-1	Test tasks. Oral individual survey.	30	Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
			Monito-ring the			Current testing. Oral individual survey.	20	20

			student's individual work			Writing a report on an individual task (or preparing an audio report).	20	12
7.	3	Current monito-ring	Control of mastering the topic	Metabo-lomics	UC-1	Test tasks. Oral individual survey.	30	Computer testing (the variant is formed by random sampling)
						Current testing. Control work.	6	12
			Monito-ring the student's individual work			Current testing. Oral individual survey.	20	20
						Writing a report on an individual task (or preparing an audio report).	20	12
	3	Mid-term assessm ent	**CREDIT**	All sections	UC-1	Test tasks.	200	Computer testing (the variant is formed by random sampling)
						Oral individual survey.	4	12

Examples of evaluation tools for monitoring academic performance and the results of mastering the discipline.

Control questions for the interview:

1. Goals and objectives of bioinformatics. The connection of bioinformatics with other natural sciences. Basic tools.
2. Databases. Electronic library resources. Biological classification and nomenclature.
3. The Internet. HTML. Search engines.
4. Exploring the capabilities of Excel (data entry, calculations, formulas). Determination of amino acid composition of proteins and prediction of their possible properties, functions, localization.
5. Introduction to the editor of chemical formulas ChemSketch. Functionality, creation of graphic illustrations of formulas of complex organic compounds and chemical reactions.
6. PDB. The structure of the PDB record. Visualization, analysis of structural features, modeling, prediction of the secondary and tertiary structure of proteins using the RasMol program.
7. Prediction of the parameters of the DNA helix.
8. Prediction and representation of the secondary structure of RNA. Minimizing the energy of the secondary structure (dynamic programming).
9. Basics of database structures (records, fields, objects). Classification of databases by filling method (automatic, archived, supervised). Main databases: GenBank, EMBL, SwissProt, TrEMBL, PIR, PDB.
10. Databases containing the results of global experiments on expression analysis, proteomics, etc. Banks of protein families (SCOP, Prosite, ProDom, PFAM, InterPro).
11. Metabolic databases. Genetic banks (physical cards, OMIM). Specialized data banks.
12. Familiarity with the family of programs used to search for homologues of proteins and nucleic acids according to the available primary sequence. Study of functional features of the main groups of programs: nucleotide (megablast, dmegablast, blastn), protein (blastp, cdart, rpsblast, psi-blast, phi-blast).
13. Familiarity with the family of programs used to search for homologues of proteins and nucleic acids according to the available primary sequence. Study of functional features of the main groups of programs: broadcasting (blastx, tblastn, tblastx), genomic and special (bl2seq, VecScreen).

14. Familiarity with the knowledge base on the systematic analysis of gene functions. Familiarization with the main databases: metabolic pathways (PATHWAY), genes (GENES), ligands (LIGAND), experimental data on gene expression (EXPRESSION and BRITE) and proteins (SSDB).
15. Comparison of metabolic pathways of different organisms and their changes in the course of evolution.

Test tasks:

1. The key objects of bioinformatics are:
   a. Internal combustion engine;
   б. Biological sequences (amino acids and nucleic acids);
   в. Ultracentrifuge;
   г. Fossils of the Jurassic period.

2. The primary sequence of proteins is:
   a. A set of α-helices and β-strands of one protein;
   б. A set of protein globules;
   в. Amino acid sequence of the protein;
   г. The sequence of nucleotides that make up the structural part of the protein gene.

3. Rasmol is
   a. A computer program designed to visualize molecules and used primarily to study and obtain images of the spatial structures of biological macromolecules;
   б. A family of computer programs used to search for homologues of proteins or nucleic acids for which the primary structure (sequence) or its fragment is known;
   в. Graphic editor of chemical formulas and reactions;
   г. A program for working with spreadsheets, providing opportunities for economic and statistical calculations and graphical tools.

4. GenBank is:
   a. A database of protein sequences available to all users;
   б. Database of protein families;
   в. A database containing annotated DNA and RNA sequences maintained by the US National Center for Biotechnology Information and available free of charge to researchers around the world;
   г. A data bank of 3-D structures of proteins and nucleic acids, in which information is obtained by X-ray crystallography or NMR spectroscopy.

8. Educational, methodological and informational support for mastering the academic discipline (printed, electronic publications, the Internet and other network resources)

8.1. Key literature references

№ p/p	Name according to bibliographic requirements	Number of copies	
		at the department	in the library
1.	Stefanov V. E., Tulub A. A., Mavropulo-Stolyarenko G. R. Bioinformatics. Moscow: YURAYT.2022.	-	https://www.litres.ru/aleksandr-aleksandrovich-tulub/bioinformatika-uchebnik-dlya-akademicheskogo-bakalavriata-21162677
2.	Chasskikh N.Yu. Bioinformatics. Moscow:GEOTAR-Media. 2020. 352 p.	-	https://mbookshop.ru/shop/uchebnaya-literatura/bioinformatika-uchebnik

8.2. Further reading

№	Name according to bibliographic requirements	Number of copies	
		at the department	in the library
1.	Gelman V.Ya. Medical informatics. The workshop. Peter. 2016.	2	2 electron.resource http://www.studmedlib.ru/book/ISBN9785970436899
2.	Zarubina T.V., Kobrinsky B.A. Medical informatics. Moscow: GEOTAR Media. 2016	-	electronic resource http://www.studmedlib.ru/book/ISBN9785970436899html

8.3. Electronic educational resources for teaching academic subjects

8.3.1. Internal Electronic Library System of the University (IELSU)

№	*Name of the electronic resource*	*Brief description (content)*	*Access conditions*	*Number of users*
	Internal Electronic Library System (EBS)	The works of the academic staff of the Academy: textbooks and manuals, monographs, collections of scientific papers, scientific articles, dissertations, abstracts of dissertations, patents.	from any computer located on the Internet, using an individual login and password [Electronic resource] – Access mode: http://95.79.46.206/login.php	Not limited

8.3.2. Electronic educational resources acquired by the University

№	*Name of the electronic resource*	*Brief description (content)*	*Access conditions*	*Number of users*
	Electronic database "Student Consultant"	Educational literature + additional materials (audio, video, interactive materials, test tasks) for higher medical and pharmaceutical education. Publications are structured by specialties and disciplines in accordance with the current Federal State Educational Standards of Higher Education.	from any computer located on the Internet, using an individual login and password [Electronic resource] – Access mode: http://www.studmedlib.ru /	General PIM subscription
	Electronic library system "Bukap"	Educational and scientific medical literature of Russian publishers, including translations of foreign publications.	from any computer located on the Internet by login and password, from the computers of the academy. The publications for which a subscription is issued are available for reading. [Electronic resource] – Access mode: http://www.books-up.ru/	General PIM subscription
	"Bibliopoisk"	Integrated "single window" search service for electronic catalogs, EBS and	PIM has access to the demo version of the Bibliopoisk search engine:	General PIM subscription

		full-text databases. The results of a single search in the demo version include documents from domestic and foreign electronic libraries and databases available to the university as part of a subscription, as well as from open access databases.	http://bibliosearch.ru/pimu .	
	Domestic electronic periodicals	Periodicals on medical subjects and on higher school issues	- from the academy's computers on the electronic library platform eLIBRARY.RU -magazines Media Sphere Publishing house - from library computers or provided by by the library at the request of the user [Electronic resource] – Access mode: https://elibrary.ru/	
	International scientometric database "Web of Science Core Collection"	Web of Science covers materials on natural, technical, social, and humanitarian sciences; takes into account the mutual citation of publications developed and provided by Thomson Reuters; has built-in capabilities for searching, analyzing, and managing bibliographic information.	Access is free from PIM computers [Electronic resource] – Access to the resource at: http://apps.webofknowledge.com	Access is free from PIM computers

8.3.3 Open access resources

Name of the electronic resource	*Brief description (content)*	*Access conditions*
Federal Electronic Medical Library (FEMB)	It includes electronic analogues of printed publications and original electronic publications that have no analogues recorded on other media (dissertations, abstracts, books, magazines, etc.). [Electronic resource] – Access mode: http://нэб.рф/	from any computer located on the Internet
Scientific Electronic Library eLIBRARY.RU	The largest Russian information portal in the field of science, technology, medicine and education, containing abstracts and full texts of scientific articles and publications. [Electronic resource] – Access mode: https://elibrary.ru /	from any computer located on the Internet.
Open Access Scientific Electronic Library CyberLeninka	Full texts of scientific articles with annotations published in scientific journals of Russia and neighboring countries. [Electronic resource] – Access mode: https://cyberleninka.ru /	from any computer located on the Internet
Russian State Library (RSL)	Abstracts for which there are copyright agreements with permission for their open publication [Electronic resource] – Access mode: http://www.rsl.ru /	from any computer located on the Internet
Legal reference system "Consultant Plus"	Federal and regional legislation, judicial practice, financial advice, comments on legislation, etc. [Electronic resource] – Access mode: http://www.consultant.ru/	from any computer located on the Internet
Official website of the Ministry of Health of the Russian Federation	National clinical guidelines. [Electronic resource] – Access mode: cr.rosminzdrav.ru - Clinical recommendations	from any computer located on the Internet
Official website of the Russian Respiratory Society	Modern materials and clinical recommendations for the diagnosis and treatment of respiratory diseases [Electronic resource] – Access mode: www.spulmo.ru – Russian Respiratory Society	from any computer located on the Internet
Official website of the Russian Scientific Society of Therapists	Modern materials and clinical recommendations for the diagnosis and treatment of diseases of internal organs [Electronic resource] – Access mode: www.rnmot.ru – Russian Scientific Society of Therapists	from any computer located on the Internet

9. Material and technical support for mastering an academic discipline

9.1. List of premises for classroom activities for the discipline

9.1.1. *For lectures there are:*
- BFC lecture halls (large and small halls);
- lecture hall of the Morphological Building;
- lecture hall of dormitory No. 3;
- lecture hall of building No. 9.

9.1.2. *For practical training on the basis of building No. 2 (BFC) there is:*
- 4 specially equipped rooms (classrooms) for seminars and practical classes in the study of disciplines;
- 4 display classes.

9.2. List of equipment for classroom activities for the discipline:

9.2.1. *Classrooms equipped with:*
educational boards, educational furniture, teaching materials, PC, overhead projector, multimedia projector, laptop, Internet access.

9.2.2. *A set of experimental equipment:*
- 4 specially equipped rooms (classrooms) for seminars and practical classes in the study of disciplines;
- 4 display classes.

9.3. Set of licensed and freely distributed software, including domestic production

№	*Software*	*Number of licenses*	*Type of software*	*Manufacturer*	*Number in the unified register of Russian software*	*№ and contract date*
1.	Wtware	100	Thin Client Operating System	Kovalev Andrey Alexandrovich	1960	2471/05-18 of 28.05.2018
2.	My Office Is Standard. A corporate user license for educational organizations, with no expiration date, with the right to receive updates for 1 year.	220	Office Application	LLC " NEW CLOUD TECHNO-LOGIES "	283	without limitation, with the right to receive updates for 1 year.
3.	LibreOffice		Office Application	The Document Foundation	Freely distributed software	
4.	Windows 10 Education	700	Operating systems	Microsoft	Subscrip-tion Azure Dev Tools for Teaching	
5.	Yandex.Browser		Browser	LLC «YANDEX»	3722	
6.	Subscription to MS Office Pro for 170 PCs for the FSBEI HE PRMU MOH Russia	170	Office Application	Microsoft		23618/HH10030 LLC "Softline Trade " of 04.12.2020

10. List of changes to the working program (to be filled out by the template)

Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation
(FSBEI HE "PRMU" of the Ministry of Health of Russia)

Department of
MEDICAL BIOPHYSICS

CHANGE REGISTRATION SHEET

working program for the academic discipline
BIOINFORMATICS IN MEDICINE

Field of study / specialty / scientific specialty: _____
(code, name)

Training profile: _____
(*name) - for master's degree programs*

Mode of study: _____
full-time/mixed attendance mode/extramural

Position	Number and name of the program section	Contents of the changes made	Effective date of the changes	Contributor's signature
1				

Approved at the department meeting
Protocol No. _____of _____20__

Head of the Department
_____ _____/_____
department name, academic title signature print name