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MINISTRY OF SCIENCE AND HIGHER EDUCATION

RUSSIAN FEDERATION

Federal State Autonomous Educational Institution of Higher Education

NORTH-CAUCASUS FEDERAL UNIVERSITY

APPROVED

Assoc. Prof. Kubanov S.I.

PhD in Medical Sciences

Dean

Faculty of Medicine and Biology

COURSE OUTLINE OF THE DISCIPLINE (MODULE)

Information Technology in Biology and Medicine

Name of the discipline (module)

- Specialty: 31.05.01 General Medicine
- Mode of training: Full-time
- Year of commencement of studies: 2026
- Delivered in Semester 4, 5

Developed by:

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1. Aim and Objectives of Mastering the Discipline (Module)

Aim of mastering the discipline: to develop in students systematic knowledge and practical skills in the application of modern information technologies for solving professional problems in biology and medicine, as well as for increasing the efficiency of the diagnostic and treatment process.

Objectives of mastering the discipline:

- To form an understanding of modern information technologies, principles of storage, retrieval, processing, and analysis of biomedical information using computer technologies.
- To teach how to work with medical information systems, automated workstations for healthcare professionals, and clinical decision support systems.
- To develop skills in applying methods of mathematical statistics and specialized software for processing biomedical data.
- To build competencies in evidence-based medicine, working with bibliographic resources, and searching for medical information on the global Internet.
- To introduce the fundamentals of information security, legal data protection, and electronic health.
- To motivate students to use information technologies in their future professional activities and for studying related disciplines.

2. Place of the Discipline (Module) in the Structure of the Training (educational) Program

The discipline " Information Technology in Biology and Medicine " belongs to the compulsory part of the curriculum, which is shaped by the participants of educational relations.

3. List of Potential Learning Outcomes for the Discipline (Module), Correlated with the Outcomes of Mastering the Educational Program

Code and definition of the competence	Code and definition of the indicator	Planned learning outcomes for the discipline (module) describing the stages of competency and indicator development
UC-4. Capable of searching, critically analyzing and synthesizing information, applying a systematic approach to solve assigned tasks	UC-4.1. Analyzes a task, identifying its basic components, performs decomposition of the task	Know: basic methods and tools for searching, systematizing and processing information. Be able to: apply a systematic approach to information analysis, structure data. Master: skills of critical analysis of information, working with various data sources.
	UC-4.2. Finds and critically analyzes information	Know: modern information resources and methods of

	necessary for solving the assigned task	working with them. Be able to: conduct effective information retrieval on the Internet and in specialized databases. Master: skills of assessing the reliability and relevance of information.
	UC-4.3. Uses logical and methodological tools for critical evaluation of modern concepts	Know: logical methods of information processing and their role in professional activities. Be able to: identify contradictions and gaps in information. Master: methods of systematizing and generalizing information for decision-making.
PC-11. Capable of applying information technologies and software tools in solving professional tasks	GPC-11.1. Selects and applies modern information technologies and software tools for solving professional tasks	Know: classification of software, principles of functioning of modern IT. Be able to: choose optimal software tools for a specific professional task. Master: skills of working with general-purpose application software.
	GPC-11.2. Uses office suite tools for processing textual, numerical and graphical information	Know: functional capabilities of office application software packages (word processors, spreadsheets, presentation tools). Be able to: create, format and edit text documents, spreadsheets, presentations. Master: skills of working with documents, tables and graphic objects in office applications.
PC-12. Ability to apply information technologies and methods of evidence-based medicine in the diagnosis, treatment, and prevention of diseases, including the use of clinical decision support systems.	GPC-12.1. Uses clinical decision support systems and medical information systems in professional activities.	Know: - the principles of building and functioning of clinical decision support systems (CDSS) and medical information systems (MIS); - the main types of CDSS (rule-based systems, machine learning models, knowledge bases) and their role in evidence-based medicine; - the principles of integrating

		AI tools into the workflow of a medical professional (diagnostics, treatment selection, prognosis). Be able to: - use clinical decision support systems and AI tools to analyze symptoms, interpret laboratory and instrumental data, and formulate differential diagnoses; - simulate clinical cases and scenarios using generative neural networks for educational and practical purposes; - evaluate the recommendations of CDSS and AI systems from the standpoint of evidence-based medicine and clinical guidelines; - work with electronic health records (EHR) and medical information systems, including the use of AI modules for data entry and processing. Master: - skills in working with clinical decision support systems and AI tools in the diagnostic and treatment process; - skills in critically evaluating recommendations generated by CDSS and making informed clinical decisions; - skills in integrating information technologies into the practical activities of a medical professional
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4. Volume of the Academic Discipline (Module) and Control *

Volume of classes: Total: 2 ECTS credits, 144 academic hours.	Full-time type of study, in academic hours
Face-to-face work	
Lectures / including practical training	32

Laboratory works / including practical training	
Practical classes / including practical training	64
Independent work	48
Forms of control	
Examination	
Credit (Pass/Fail)	
Graded credit (Graded Pass/Fail test)	

** The discipline (module) provides for the use of e-learning and remote learning technologies (unless otherwise set by the educational standard).*

5. Content of the Discipline (Module), Structured by Topics (Sections) with an Indication of the Hours and Types of Classes

#	Section (topic) of the discipline and brief content	Competencies and indicators to be developed	Full-time training				Forms of current control of academic progress
			Contact work of students with the teacher / of them practical skills training, hours			Independent work, hours	
			Lectures	Practical classes	Laboratory work		
1	Introduction to Generative Neural Networks and Fundamentals of Prompt Engineering for Biomedicine.	UC-4 (Ability to use AI tools for information gathering and analysis); Indicator: Composes structured prompts to obtain biomedical knowledge.	4	8		6	Interview
2	Translation, Adaptation, and Summarization of Scientific Literature in Biology and Medicine.	UC-4 (Ability to analyze scientific literature using AI); Indicator: Translates, structures, and summarizes an article on a given topic within 15 minutes.	4	8		6	Presentation of laboratory work

3	Interactive Study of Molecular Biology and Genetics Using Neural Networks.	UC-4 (Ability to interpret biological data using AI); Indicator: Obtains a structured description of any gene or biochemical process from the neural network.	4	8		6	Testing
4	Simulation of Clinical Cases and Differential Diagnosis Using AI.	UC-4 (Ability to model clinical scenarios); Indicator: Compiles 3 clinical cases, tests them through the neural network, and critically evaluates the responses.	4	8		6	Presentation of project
	TOTAL in 4 Semester		16	32		24	
5	Processing and Structuring of Medical Documentation.	PC-12 (Ability to structure medical texts using AI); Indicator: Transforms chaotic text into a checklist of diagnoses, medications, and dates.	4	8		6	Presentation of laboratory work
6	Pharmacology and Drug Interactions: AI Assistance in Working with Medications.	PC-11 (Ability to apply AI in pharmacovigilance and clinical pharmacology); Indicator: Obtains structured information about a drug and warnings about interactions from the neural network.	4	8		6	Presentation of laboratory work

7	Generation of Educational and Methodological Materials for Medical Education.	PC-11 (Ability to create educational content using AI); Indicator: Generates a test of 20 questions and an educational table on a given topic.	4	8		6	Presentation of laboratory work
8	Critical Thinking, Fact Validation, and Hallucination Mitigation.	PC-12 (Ability to assess the reliability of AI responses and correct them); Indicator: Identifies and corrects errors in a medical text generated by the neural network.	4	8		6	Presentation of project
	TOTAL in 5 Semester		16	32		24	
	TOTAL		32	64		48	

6. Assessment Tools Fund for the Discipline (Module)

The assessment tools fund (ATF) for the discipline (module) Information Technology in Biology and Medicine is based on the list of competencies to be mastered, indicating the stages of their formation in the process of mastering the discipline (module). The ATF provides an objective control over the achievement of the planned learning outcomes. The ATF includes:

- A description of indicators and criteria for evaluating competencies at various stages of their formation, a description of evaluation scales;
- Methodological materials determining the procedures for evaluating knowledge, skills, abilities and (or) work experience characterizing the stages of competency formation;
- Standard control tasks and other materials necessary for assessing knowledge, skills, and the level of mastery of the formed competencies in the process of mastering the discipline (module).

The ATF is an appendix to this discipline (module) program.

7. Methodological Guidelines for Students on Mastering the Discipline

When starting work, each student must take into account the following provisions.

The discipline (module) is structured on a thematic principle; each topic represents a logically completed section.

Practical classes are conducted with the aim of consolidating the mastered information, acquiring skills for its application in solving practical problems in the relevant subject area.

The independent work of students is aimed at the independent study of additional material, preparation for practical and laboratory classes, as well as the execution of all types of independent work.

In order to successfully master the discipline, it is important to complete all types of independent work employing the recommended sources of information.

8. Educational, Methodological, and Informational Support for the Discipline

8.1. List of Main and Additional Literature Required for Mastering the Discipline (Module)

8.1.1. List of Main Literature:

- 1) Shortliffe, E.H., Cimino, J.J. (Eds.). Biomedical Informatics: Computer Applications in Health Care and Biomedicine. – 5th ed. – Springer, 2021. – 1152 p.
- 2) Coiera, E. Guide to Health Informatics. – 3rd ed. – CRC Press, 2015. – 705 p.
- 3) Nelson, R., Staggers, N. Health Informatics: An Interprofessional Approach. – 2nd ed. – Elsevier, 2018. – 576 p.

8.1.2. List of Additional Literature:

- 1) Topol, E.J. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again. – Basic Books, 2019. – 400 p.
- 2) Sahni, N.R., et al. Artificial Intelligence in U.S. Health Care Delivery. – New England Journal of Medicine, 2021. – Vol. 384, pp. 1176–1181.

8.2. List of Educational and Methodological Support for the Independent Work of Students in the Discipline (Module)

- 1) <https://eios.ncfu.ru/>
- 2) <https://stepik.org/>

8.3. List of Resources of the Information and Telecommunications Network **Internet** Required for Mastering the Discipline (Module)

- 1) <https://www.ncbi.nlm.nih.gov/pmc/>
- 2) <https://cyberleninka.ru/>

9. List of Information Technologies Employed through the Discipline (Module), Including a List of Software and Information Reference Systems

When delivering lectures, computer equipment and demonstrations of multimedia presentation materials are used. In seminars and practical classes, students deliver presentations prepared by them during the hours of independent work.

Information Reference Systems:

Information-reference and information-legal systems used in the study of the discipline:

1.	https://support.microsoft.com/
2.	eLIBRARY.RU

Software:

1.	Alt Workstation 10
2.	Alt Workstation K
3.	Alt Server
4.	Office software package – P7-Office

10. Description of the Material and Technical Resources Required for the Educational Process for the Discipline (Module)

Practical classes	A classroom, equipped with multimedia equipment and technical training facilities.
Independent work	A room for the independent work of students, equipped with computer hardware with the capability to connect to the Internet network and provide access to the electronic information and educational environment of the university.

11. Specific Features of Mastering the Discipline (Module) by Persons with Disabilities

Students with disabilities shall be provided with special textbooks, teaching aids, and didactic materials, special technical training facilities for collective and individual use, the

services of an assistant (helper) providing the necessary technical assistance to the students, as well as the services of sign language interpreters and tactile sign language interpreters.

The mastery of the discipline (module) by students with disabilities may be organized jointly with other students, as well as in separate groups.

Mastering the discipline (module) by students with disabilities is to be carried out taking into account the peculiarities of psychophysical development, individual capabilities, and health status.

In order to ensure the accessibility of higher education under the educational program for persons with disabilities, the following is provided during the mastery of the discipline (module):

- 1) for persons with visual impairments:
 - the presence of an assistant offering the student the necessary technical assistance, taking into account individual features (help taking the workplace, moving around, reading and formatting the task, including writing under dictation),
 - written tasks, as well as instructions on the procedure for their execution, are formatted in an enlarged font,
 - special textbooks, teaching aids, and didactic materials (having a large font or audio files),individual uniform lighting of at least 300 lux,
if necessary, a magnifying device is provided to the student to complete the task;
- 2) for persons with hearing impairments:
 - the presence of an assistant providing the student with the necessary technical assistance, taking into account individual characteristics (helps to take a workplace, move around, read and format the task, including writing with dictation),
 - the availability of sound-amplifying equipment for collective use is ensured; if necessary, sound-amplifying equipment for individual use is provided to the student;
 - provision with proper sound means of reproducing information is ensured;
- 3) for persons with musculoskeletal disorders (including severe motor function impairments of the upper limbs or the absence of upper limbs):
 - written tasks are performed on a computer with specialized software or are dictated to an assistant;
 - at the request of the student, tasks may be performed verbally.

12. Specific Features of Implementing the Discipline with the Use of Distance Learning Technologies and E-Learning

Subject to Part 1 of Article 16 of the Federal Law of December 29, 2012, No. 273-FZ On Education in the Russian Federation, e-learning shall be viewed as the arrangement of educational activities employing information contained in databases and used in the implementation of educational programs, as well as information technologies, technical means, and information and telecommunication networks that ensure the processing and transmission of the specified information via communication lines, and the interaction of students and pedagogical workers.

Remote (distance) learning technologies are understood as educational technologies implemented mainly with the use of information and telecommunication networks during the indirect (at a distance) interaction of students and pedagogical workers.

The implementation of the discipline may be carried out with distance learning technologies and e-learning in full or in part. The components of the Educational And Methodological Complex (EMC) of the discipline (working program of the discipline, assessment and methodological materials, forms of attestation) implemented with the use of distance learning technologies and e-learning contain an indication of their use.

When arranging educational activities with distance learning technologies and e-learning, asynchronous and synchronous methods of interaction between participants in educational relations via the information and telecommunications network Internet may be offered.

When using distance learning technologies and e-learning, the schedule for the discipline shall indicate: methods of interaction among participants in educational relations via the information and telecommunications network Internet (VCC – videoconferencing, ET – electronic testing); links to the electronic information and educational environment of NCFU, to educational platforms and resources of other organizations to which open access is provided via the information and telecommunications network Internet; for synchronous learning – the time of online classes and instructors; for asynchronous learning – the authors of online courses.

When arranging intermediate attestation with distance learning technologies and e-learning, the Methodological Recommendations on the use of technical means ensuring the objective reliability of results when conducting intermediate and state final attestation for higher education educational programs – Bachelor's Degree programs, Specialist's Degree programs, and Master's Degree programs with distance learning technologies are used (Letter of the Ministry of Science and Higher Education of Russia dated December 7, 2020, # MN-19/1573-AN On sending methodological recommendations).

The implementation of the discipline with the use of e-learning and distance learning technologies is carried out using the electronic information and educational environment of NCFU, to which students are provided access via the information and telecommunications network Internet, or using the resources of other organizations, including platforms providing services for videoconferencing, online meetings, and distance learning (MTS-Link), as well as using the capabilities of social networks to carry out communication between students and instructors.

The educational and methodological support for a discipline shall be ensured with e-learning and distance learning technologies includes the working program presented in electronic form, educational and methodological manuals or a course of lectures, methodological guidelines for performing various types of educational activities of students provided for by the discipline, and other educational and methodological materials posted in the information and educational environment of NCFU.