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**Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
RUDN University**

Agrarian and Technological Institute

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Biological physics

course title

Recommended by the Didactic Council for the Education Field of:

36.05.01 Veterinary

field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:

36.05.01 Veterinary

higher education programme profile/specialisation title

1. GOALS AND OBJECTIVES OF THE COURSE

The aim of mastering the course "**Biological physics**" is the formation of basic knowledge of the basic physical laws and principles of the first-year students, their role in the functioning of biological systems; mastering physical and mathematical methods for describing phenomena and techniques for conducting an experiment within the framework of the methodology of physics as an exact science; formation of ideas about the physical foundations of modern instrumental methods in biology, medicine and veterinary medicine.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The implementation of the course "**Biological physics**" is aimed at creating the following competencies (parts of competencies) for students:

Table 2.1. List of competencies formed by students during the development of the course (results of the development of the course)

Competence code	Competence descriptor	Indicators of competence accomplishment (within the course)
GC-8	Is able to create and maintain safe living conditions in everyday life and professional activities to preserve the natural environment, ensure the sustainable development of society, including the threat and emergence of emergencies and military conflicts	GC-8.1 Analyzes factors of harmful influence on the life activity of elements of the environment (technical means, technological processes, materials, buildings and constructions, natural and social phenomena);
		GC-8.2 Identifies hazardous and harmful factors within the scope of the job;
GPC-4	Is able to use in professional activity methods to solve problems using modern equipment in the development of new technologies and use modern professional methodology to conduct experimental research and interpretation of the results	GPC-4.1 Has the conceptual and methodological apparatus of the basic natural sciences at a level sufficient for full professional activity at the modern level
		GPC-4.3 Willing to use modern methodology in designing and conducting experimental research
		GPC-4.4 Uses modern professional methodology in interpreting research results

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course "**Biological physics**" refers to the mandatory part of block B1 of the Educational Program of Higher Education.

As part of the Educational Program of Higher Education, students also master other courses and /or practices that contribute to achieving the planned results of mastering the course "**Biological physics**".

Table 3.1. List of Higher Education Program components courses that contribute to expected learning outcomes

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
GC-8	Is able to create and maintain safe living conditions in everyday life and professional activities to preserve the natural environment, ensure the sustainable development of society, including the threat and emergence of emergencies and military conflicts	Basics of Professional Ethics Inorganic and analytical chemistry Organic chemistry	Life safety Veterinary Microbiology and Mycology Virology and biotechnology Veterinary radiobiology General and Veterinary Ecology Study practice Preparation for and passing the state exam
GPC-4	Is able to use in professional activity methods to solve problems using modern equipment in the development of new technologies and use modern professional methodology to conduct experimental research and interpretation of the results	Inorganic and analytical chemistry Organic chemistry	Physical and Colloidal Chemistry Biological chemistry Maths Immunology Laboratory diagnostics of infectious and invasive diseases Veterinary and industrial laboratories with design basics Study practice Clinical internship Industrial practice Academic research practice with the preparation of a scientific qualification project Preparation for and passing the state exam

4. COURSE WORKLOAD AND TRAINING ACTIVITIES

Course workload of the course "Б" is 2 credits.

Table 4.1. Types of academic activities during the period of the HE program mastering for *full-time* study

Types of academic activities		HOURS	Semesters				
			2	-	-	-	
Contact academic hours		54	54	-	-	-	
including							
Lectures		18	18	-	-	-	
Lab work		36	36			-	
Seminars (workshops/tutorials)		-	-	-	-	-	
Self-study		12	12	-	-	-	
Evaluation and assessment (exam/pass/fail grading)		6	6	-	-	-	
Course workload		Academic hour	72	72	-	-	-
		Credit unit	2	2	-	-	-

5. COURSE CONTENTS

Table 5.1 Content of the course (module) by type of academic work

Modules	Content of the modules (topics)	Types of academic activities
Module 1. Introduction	Topic 1.1. Subject of physics and biological physics. Physical quantities, units of measurement and systems of units. Elements of vector algebra and mathematical analysis. Elements of the theory of errors and processing of experimental data.	Lectures, Lab work.
Module 2. Mechanics. Oscillations and waves.	Topic 2.1. Material point kinematics. Basic kinematic characteristics: trajectory, path, displacement vector, instantaneous and average speed, acceleration. Types of mechanical movement. Circular movement. Dynamics. Newton's laws. Types of forces in mechanics. Translational and rotational motion of a rigid body. Moment of power. Work, power, energy. Elements of biomechanics. Free fall. Orbital motion and space velocities. Weight, weightlessness and overload. Biological action of weightlessness and overload. Ballistocardiography. Conservation laws in mechanics:	Lectures, Lab work.

		<p>momentum, energy, angular momentum. Work and power of living organisms. Ergometry.</p> <p>Oscillatory motion. Harmonic vibrations and their characteristics. Damped and forced oscillations. Resonance. Waves. Transverse and longitudinal waves. Elements of acoustics. The nature of sound vibrations, physical and psychophysical characteristics of sound. Weber-Fechner psychophysiological law. Logarithmic units of loudness levels. Hearing ranges for humans and animals. Ultrasound and infrasound. The use of ultrasound in medicine. Influence of infrasound on living organisms. Doppler effect and its application in medicine.</p>	
Module 3. Hydrodynamics	3.	<p>Topic 3.1. Basic properties of liquids. Pressure, Pascal's law. Jet continuity equation. Bernoulli's equation. Viscosity. Viscous fluid flow. Poiseuille's formula. Laminar and turbulent flow. Elements of hemodynamics. Clinical method for determining blood viscosity. Viscometers. The circulatory system is like a branch of the tubes. Mechanical work and the power of the heart. Blood pressure.</p>	Lectures, Lab work.
Module 4. Molecular physics and thermodynamics	4.	<p>Topic 4.1. Elements of classical molecular kinetic theory (MKT). The amount of substance. Basic equation of MKT. Temperature. Ideal gas laws. Elements of thermodynamics. Internal energy of gas. Heat capacity. Adiabatic process. Real gases. Van der Waals equation. Surface tension in a liquid. Wetting and capillary phenomena. Irreversibility of real thermodynamic processes. The first and second law of thermodynamics. Entropy. Living organisms as thermodynamic systems. Entropy of biological systems.</p>	Lectures, Lab work.
Module 5. Electricity and magnetism	5.	<p>Topic 5.1. Electrical interaction and charge. Electric field and its characteristics. Conductors and dielectrics in an electrostatic field.</p>	Lectures, Lab work.

	<p>Electric capacity. The heart is like an electric dipole. Physical foundations of electrocardiography. Direct electric current, electromotive force and voltage of the current source. Electrical resistance. Work and power of the current. Basic laws of direct current. Direct current electrical conductivity of biological tissues and fluids. The primary effect of direct current on body tissues. Galvanization. Electrophoresis of medicinal substances.</p> <p>Magnetic phenomena. Magnetic field characteristics. Ampere force. Magnetic field in matter. Lorentz force. The phenomenon of electromagnetic induction. Faraday's law. Self-induction. Alternating electric current. Electromagnetic waves, scale of electromagnetic waves. Biological action of high-frequency electromagnetic radiation. UHF therapy. The use of ultraviolet radiation (luminescence analysis) in veterinary and sanitary examination.</p>	
<p>Module 6. Optics and elements of atomic physics</p>	<p>Topic 6.1. About the nature of light. Geometric optics. The laws of reflection and refraction of light. Thin lenses. The eye as an optical system. Sensitivity of the eye to light and color. Disadvantages of the optical system of the eye and their elimination. Dispersion of light. Light interference. Light diffraction. Light polarization. Study of biological tissues in polarized light. Quantum properties of light. Emission and absorption spectra. Photo effect. The principle of operation of optical devices. Angular and linear magnification. Microscope and its characteristics. Biological action of light. The structure of the atom, Bohr's postulates and the periodic table of elements. Features and nature of nuclear forces. The composition of the nuclei. Isotopes. Radioactivity. The law of radioactive decay. Mass and energy. The biological effect of radioactive</p>	<p>Lectures, Lab work.</p>

	radiation. Dosimetry elements. X-ray radiation and its use in medicine.	
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6. COURSE EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Material and technical support of the course

<i>Classroom for Academic Activity Type</i>	<i>Equipping the classroom</i>	Specialized educational/laboratory equipment, software and materials for the development of the course (if necessary)
Lecture	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a board (screen) and technical means of multimedia presentations.	-
Laboratory	An auditorium for laboratory work, individual consultations, routine monitoring and interim certification, equipped with a set of specialized furniture and equipment.	-
Self-studies	An auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to an electronic information and educational environment.	-

7. RESOURCES RECOMMENDED FOR COURSE STUDIES

Main readings:

1. Grabovsky R.I. Physics course (for agricultural institutes). - M., 2006
2. Trofimova T.I. Physics course (for engineering universities). - M., 1997
3. Remizov A.N. Medical and biological physics. - M., 2001
4. Tishchenko A.A., Kassandrov V.V. Physics with the basics of medical electronics. - M., UDN, 1989
5. Marion JB General physics with biological examples. - M.: Mir, 1986 (see the Reading Room of the RUDN University Library)

Additional Readings:

1. Belanovsky A.S. foundations of biophysics in veterinary medicine: textbook for universities - M. Drofa, 2007.
2. Antonov V.F., Korzhuev A.V. Physics and biophysics. A course of lectures for medical students. - M.: GEOTAR-MED, 2004

3. H. Kuhling. Physics Handbook. Per. with him. - M: Mir, 1982
4. Course of physics [Electronic resource]: in 2 volumes: textbook. T. 1 / ed. : V. N. Lozovsky. - 6th ed., Rev. and add. - SPb. : Lan, 2009 ., - ISBN 978-5-8114-0286-1.
5. KV Pokazeev et al. Collection of problems in physics for food and agricultural universities: textbook. manual for full-time and part-time students of food and agricultural universities. - SPb. : Doe, 2006
6. Yan Padamanov. Collection of formulas in physics. For students, teachers, schoolchildren, applicants. Publisher: Peter, 2018

Internet sources

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:

- RUDN Electronic Library System (RUDN ELS) <http://lib.rudn.ru/MegaPro/Web>
- EL "University Library Online" <http://www.biblioclub.ru>
- EL "Yurayt" <http://www.biblio-online.ru>
- EL "Student Consultant" www.studentlibrary.ru
- EL "Lan" <http://e.lanbook.com/>
- EL "Trinity Bridge"

2. Databases and search engines:

- electronic foundation of legal and normative-technical documentation <http://docs.cntd.ru/>
- Yandex search engine <https://www.yandex.ru/>
- Google search engine <https://www.google.ru/>
- Scopus abstract database <http://www.elsevierscience.ru/products/scopus/>

Educational and methodological materials for independent work of students during the development of the course/ module*:

1. A course of lectures on the course "**Biological physics**".
2. Laboratory workshop on the course "**Biological physics**".

* - The training toolkit and guidelines for the internship are placed on the internship page in the university telecommunication training and information system under the set procedure.

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS COURSE RESULTS

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as the course results are specified in the Appendix to the course syllabus.

* The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

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Position, Basic curriculum

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