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**Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
Agrarian and Technological Institute**

WORKING COURSE SYLLABUS

Biological physics

Recommended by the Methodological Council for the Education Field:

36.05.01 Veterinary medicine

2022 г.

1. GOALS AND OBJECTIVES OF THE DISCIPLINE

The aim of mastering the discipline "**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 THE RESULTS OF MASTERING THE DISCIPLINE

The development of the discipline "**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 discipline (results of the development of the discipline)

Code	Competence	Indicators of competence accomplishment (within the discipline)
UK -8	The ability to create and maintain safe living conditions in everyday life and in professional activities for the preservation of the natural environment, ensuring the sustainable development of society, including in the event of a threat and occurrence of emergencies and military conflicts.	UK-8.1 Analyzes the factors of harmful influence on the vital activity of elements of the habitat. (technical means, technological processes, materials, buildings and structures, natural and social phenomena);
		UK -8.2 Identifies dangerous and harmful factors within the scope of the task being performed;
		UK-8.3 Identifies and eliminates problems related to safety violations in the workplace;
		UK-8.4 Explains measures to prevent emergencies;
		UK -8.5 "Explains the rules of conduct in the event of emergencies of natural and man-made origin, as well as in the event of military conflicts;"
		UK-8.6 Provides first aid, participates in recovery activities.
GPC -4	The ability to use methods of solving problems using modern equipment in the development of new technologies in professional activity and to use modern professional methodology for conducting experimental research and interpreting their results.	GPC-4.1 Possesses the conceptual and methodological apparatus of basic natural sciences at a level sufficient for full-fledged professional activity at the modern level.
		GPC-4.2 He knows the methods of solving problems using modern equipment.
		GPC-4.3 He is ready to use modern methodology in the development and conduct of experimental research.
		GPC-4.4 Uses modern professional methodology in interpreting research results.

PC -3	Ability to develop animal research programs using special (instrumental) and laboratory methods.	PC-3.1 He is able to develop individual animal research programs, including the use of special (instrumental) and laboratory methods to detect deviations from the physiological norm of the state of a living organism, conduct differential diagnosis of the detected pathology or control the course of the disease and the effectiveness of the prescribed treatment.
		PC-3.2 Capable of developing mass comprehensive animal research programs (medical examination programs) of animals, taking into account their type and purpose, both general and special.
PC -4	The ability to conduct clinical studies of animals using special (instrumental) and laboratory methods to clarify the diagnosis.	PC-4.1 Able to conduct additional animal studies using laboratory methods to clarify the diagnosis.
		PC-4.2 Able to conduct additional animal studies using special (instrumental) methods to clarify the diagnosis.

3. COURSE IN HIGHER EDUCATION

The discipline "**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 disciplines and /or practices that contribute to achieving the planned results of mastering the discipline "**Biological physics**".

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

Шифр	Наименование компетенции	Предшествующие дисциплины/модули, практики	Последующие дисциплины/модули, практики
UK-8	The ability to create and maintain safe living conditions in everyday life and in professional activities for the preservation of the natural environment, ensuring the sustainable development of society, including in the event of a threat and occurrence of emergencies and military conflicts.	History Inorganic and analytical chemistry Organic chemistry	Physical and Colloidal Chemistry Life safety Biological chemistry Veterinary Microbiology and Mycology Virology and biotechnology Veterinary radiobiology Parasitology and invasive diseases Epizootology and infectious diseases

			<p>Organization of veterinary affairs General and Veterinary Ecology Veterinary sanitation Veterinary deontology Laboratory diagnostics of infectious and invasive diseases Organization of state veterinary supervision</p>
GPC-4	<p>The ability to use methods of solving problems using modern equipment in the development of new technologies in professional activity and to use modern professional methodology for conducting experimental research and interpreting their results.</p>	<p>Inorganic and analytical chemistry Organic chemistry</p>	<p>Computer science Physical and Colloidal Chemistry Cytology, Histology and Embryology Biological chemistry Veterinary Microbiology and Mycology Virology and biotechnology Physiology and ethology of animals Breeding with the basics of private animal husbandry Pathological physiology Veterinary radiobiology Clinical diagnostics Pathological anatomy Operative surgery with topographic anatomy Instrumental diagnostic methods Toxicology Obstetrics, gynecology and andrology Internal diseases General surgery Private Veterinary Surgery Parasitology and invasive diseases Epizootology and infectious diseases Maths Immunology Veterinary sanitation</p>

			Processing technology for livestock products Medicinal and poisonous plants Fodder plants The basics of intellectual work Personality psychology and professional self-determination Clinical laboratory diagnostics Laboratory diagnostics of infectious and invasive diseases Horse diseases Diseases of Productive Animals Diseases of small pets Болезни мелких домашних животных Diseases of bees and entomophages Fish pathology and aquaculture Diseases of exotic animals Anesthesiology, resuscitation and intensive care Dermatology Cardiology Endocrinology Nephrology Reconstructive surgery Veterinary ophthalmology Animal Dentistry
PC-3	Ability to develop animal research programs using special (instrumental) and laboratory methods.	Animal anatomy Organic chemistry	Physical and Colloidal Chemistry Biological chemistry Veterinary Microbiology and Mycology Virology and biotechnology Physiology and ethology of animals Pathological physiology Clinical diagnostics Pathological anatomy

			Instrumental diagnostic methods Toxicology Obstetrics, gynecology and andrology Internal diseases General surgery Private Veterinary Surgery Parasitology and invasive diseases Epizootology and infectious diseases Immunology Veterinary deontology Clinical laboratory diagnostics Laboratory diagnostics of infectious and invasive diseases Veterinary and industrial laboratories with design basics Horse diseases Diseases of Productive Animals Diseases of small pets Болезни мелких домашних животных Diseases of bees and entomophages Fish pathology and aquaculture Diseases of exotic animals Anesthesiology, resuscitation and intensive care Dermatology Cardiology Endocrinology Nephrology Reconstructive surgery Veterinary ophthalmology Animal Dentistry
PC-4	The ability to conduct clinical studies of animals using special (instrumental) and laboratory methods to clarify the diagnosis.	Animal anatomy	Cytology, Histology and Embryology Biological chemistry Veterinary Microbiology and Mycology

			Virology and biotechnology Physiology and ethology of animals Pathological physiology Clinical diagnostics Pathological anatomy Instrumental diagnostic methods Obstetrics, gynecology and andrology Internal diseases General surgery Private Veterinary Surgery Parasitology and invasive diseases Epizootology and infectious diseases Clinical laboratory diagnostics Laboratory diagnostics of infectious and invasive diseases Horse diseases Diseases of Productive Animals Diseases of small pets Болезни мелких домашних животных Diseases of exotic animals Anesthesiology, resuscitation and intensive care Dermatology Cardiology Endocrinology Nephrology Veterinary ophthalmology Animal Dentistry
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4. COURSE WORKLOAD AND TRAINING ACTIVITIES

Course workload of the discipline "**Biological physics**" 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	-	-	-

Table 4.2. Types of academic activities during the period of the HE program mastering for *part-time* study

Types of academic activities		HOURS	Semesters				
			2	-	-	-	
Contact academic hours		18	18	-	-	-	
including							
Lectures		-	-	-	-	-	
Lab work		18	18	-	-	-	
Seminars (workshops/tutorials)		-	-	-	-	-	
Self-study		46	46	-	-	-	
Evaluation and assessment (exam/pass/fail grading)		8	8	-	-	-	
Course workload		Academic hour	72	72	-	-	-
		Credit unit	2	2	-	-	-

5. CONTENT OF THE DISCIPLINE

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

Name of the discipline section	Content of the section (topics)	Types of academic activities
Section 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.
Section 2. Mechanics. Oscillations and waves.	Topic 2.1. Material point kinematics. Basic kinematic characteristics:	Lectures, Lab work.

	<p>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: momentum, energy, angular momentum. Work and power of living organisms. Ergometry. 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>	
Section 3. Hydrodynamics	<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.
Section 4. Molecular physics and thermodynamics	<p>Topic 4.1. Elements of classical molecular kinetic theory (MKT). The amount of substance. Basic equation of MKT. Temperature. Ideal gas laws.</p>	Lectures, Lab work.

	<p>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>	
Section 5. Electricity and magnetism	<p>Topic 5.1. Electrical interaction and charge. Electric field and its characteristics. Conductors and dielectrics in an electrostatic field. 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>	Lectures, Lab work.
Section 6. Optics and elements of atomic physics	<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</p>	Lectures, Lab work.

	<p>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 radiation. Dosimetry elements. X-ray radiation and its use in medicine.</p>	
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6. CLASSROOM INFRASTRUCTURE AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Material and technical support of the discipline

<i>Classroom for Academic Activity Type</i>	<i>Equipping the classroom</i>	Specialized educational/laboratory equipment, software and materials for the development of the discipline (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. RECOMMENDED SOURCES FOR COURSE STUDIES

Main reading:

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 Reading:

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

Resources of the Internet information and telecommunication network:

1. Electronic library system of RUDN and third-party Electronic library systems to which university students have access on the basis of concluded contracts:
 - Electronic library system of RUDN - ELS RUDN <http://lib.rudn.ru/MegaPro/Web>
 - ELS "University Library online" <http://www.biblioclub.ru>
 - ELS Yurayt <http://www.biblio-online.ru>
 - ELS "Student Consultant" www.studentlibrary.ru
 - ELS "Lan" <http://eZlanbook.com/>
 - ELS "Trinity Bridge" <http://www.trmost.com/>
 2. Databases and search engines:
 - electronic fund of legal and regulatory and technical documentation <http://docs.cntd.ru/>
 - search engine Yandex <https://www.yandex.ru/>
 - search engine Google <https://www.google.ru/>
 - abstract database SCOPUS <http://www.elsevierscience.ru/products/scopus/>
- Educational and methodological materials for independent work of students during the development of the discipline/ module*:

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

* - All educational and methodological materials for independent work of students are placed in accordance with the current procedure on the discipline page in the **Telecommunication educational and Information System!**

8. MID-TERM ASSESSMENT

Evaluation materials and a point-rating system* for assessing the level of competence formation (part of competencies) based on the results of mastering the discipline "**Biological physics**" are presented in the Appendix to this Work Program of the discipline.

* - Assessment Materials and a Point Rating System are formed based on the requirements of the relevant local regulatory act of the RUDN.

DEVELOPER:

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Position, Basic curriculum

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