Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
NAMED AFTER PATRICE LUMUMBA
RUDN University
Institute of Medicine

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

COURSE SYLLABUS

Physics

course title

Recommended by the Didactic Council for the Education Field of:

31.05.03 Dentistry

field of studies / speciality code and title

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

Dentistry

higher education programme profile/specialisation title

2026

1. COURSE GOAL(s)

The mission of the **" Physics"** course for dentistry students is to provide a foundational understanding of key physics principles and their applications in dental sciences. The course aims to:

1. **Develop Scientific Competence** – Equip students with essential knowledge of mechanics, thermodynamics, electricity, optics, and radiation physics relevant to dental practice.
2. **Enhance Problem-Solving Skills** – Foster analytical and critical thinking abilities to apply physical concepts in diagnosing and addressing dental challenges.
3. **Support Clinical Applications** – Demonstrate how physics principles underpin dental technologies, such as X-rays, lasers, imaging systems, and biomechanics of dental materials.
4. **Promote Safety and Efficiency** – Educate students on the safe and effective use of physics-based dental equipment while adhering to ethical and professional standards.
5. **Prepare for Advanced Studies** – Lay a strong foundation for future learning in subjects like radiology, prosthodontics, and biomedical engineering within dentistry.

By integrating theoretical knowledge with practical examples, the course ensures that dentistry students appreciate the role of physics in modern dental care and technological advancements in the field.

2.REQUIREMENTS FOR LEARNING OUTCOMES:

Mastering the course (module) **"Physics"** is aimed at the development of the following competences /competences in part: **GPC-8.**

Table 2.1. List of competences that students acquire through the course study

Competence code	Competence descriptor	Competence formation indicators (within this course)
GPC-8	Being able to use main physical and chemical, mathematic and scientific notions and methods when dealing with professional tasks;	***GPC-8.1.*** Analyzing the factors of harmful impact on the vital functions of the elements of the environment (technical means, technological processes, materials, buildings and structures, natural and social phenomena); ***GPC-8.2.*** Identifying hazardous and harmful factors within the framework of the carried out activities; ***GPC-8.3.*** Solving problems related to unsafe behavior and participating in activities to prevent emergencies in the workplace; ***GPC-8.4.*** Observing and explaining the rules of behavior in

		case of emergencies of natural and man-made origin; providing first aid; participating in recovery activities;

3. THE COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective* component of (B1) block of the highere ducational programme curriculum.

* - Underline whatever applicable.

Within the higher education programme students also master other (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course study.

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
GPC-8	Being able to use main physical and chemical, mathematic and scientific notions and methods when dealing with professional tasks;		Biochemistry Hygiene Public health and healthcare, healthcare economics Epidemiology Neurology, Medical Biochemistry Hygiene Public health and healthcare, healthcare economics Epidemiology Neurology, medical genetics, neurosurgery Hospital therapy Endocrinology Infectious diseases Phthisiology Medical Elementology Allergology Introduction to Nutritionology

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course "**Physics**" is 2 credits (72 academic hours) .

*Table 4.1. Types of academic activities during the periods of higher education programme mastering (**full-time training**)**

Type of academic activities		Total academic hours	Semesters/training modules	Type of academic activities		
			2			
Classroom activities (total)		51	51			
Including:		-	-	-	-	-
Lectures (**LC**)		17	17			
Laboratory work (***LW***)		34	34			
Seminars (***S***)		-				
Self-studies		21	21			
Evaluation and assessment (exam/passing/failing grade)						
Total course workload	academic hours	72	72			
	credits	2	2			

* To be filled in regarding the higher education programme correspondence training mode.

5.CONTENT OF THE DISCIPLINE

Table 5.1. The content of the discipline and types of academic activities

Course module title	Course module contents (topics)	Academic activities types
Introductory lecture. **Fundamentals of vector and mathematical analysis**	Methods of processing of measurement results. Direct and indirect measurements. Theory of errors. Types of errors: gross, systematic, random; absolute, relative. Rules for registration of laboratory work. The order of writing the abstract. Safety at work in the physical laboratory. Basic concepts of mathematical and vector analysis. Derivatives and differentials. Rules for adding (subtracting) and multiplying vectors. Integration rules. Calculations of indefinite and definite integrals.	**LC, LW**
Mechanics. Dynamics, mechanical oscillations	Introduction. Definitions (kinematics, dynamics, statics, trajectory, reference systems, equation of motion). Rectilinear motion. Circular motion. Inertia. Force of inertia. Dynamics of rotational motion. Moment of inertia. The moment of impulse and the law of its preservation. Gravitational interaction. Acceleration of gravity. Weightlessness. Harmonic vibrations.	**LC, LW**

	Gravitational interaction. Acceleration of gravity.	
	Work and energy. Potential field, the work of conservative forces, potential energy. Kinetic energy. The law of conservation of energy. Rotational motion of a rigid body. A moment of strength. The basic equation of the dynamics of rotational motion. The equation of motion of the angular momentum. The law of conservation of the angular momentum.	**LC, LW**
The waves. Sound wave	Mechanical waves. The plane wave equation. Parameters of vibrations and waves. Energy characteristics. The Doppler effect and its use in medicine. Sound. Types of sounds. A complex tone and its acoustic spectrum. Wave resistance. Objective(physical)and subjective (biological) characteristics of sound. Infrasound. Ultrasound, the physical basis of application in medicine.	**LC, LW**
Hydrostatic. Molecular Physics	The viscosity. Methods for determining the viscosity of liquids. Stationary flow, laminar and turbulent flows. Newton's formula, Newtonian and non-Newtonian liquids. The Poiseuille formula. The Reynolds number. Features of hemodynamics in the main, resistive, capillary and venous vessels of the circulatory model. Work and warmth. The first beginning of thermodynamics. Heat capacity. An adiabatic process (Poisson's formula). The basic equation of molecular kinetic theory. The heat and motion of molecules. The first principle of thermodynamics applied to the human body. The role of nutrition and respiration. Internal energy. Internal pressure and surface tension in the fluid. Diffusion. Osmosis. Wetting Capillary phenomena.	**LC, LW**
Electricity and magnetism	Electric charges and their properties. Coulomb's law. The electrostatic field. Field strength. Power lines. Potential. Equipotential surfaces. The relationship between tension and potential. Conductors in an electrostatic field. Electrical capacity. Capacitors, their connection. The energy of the electric field. Current strength and current density. Electromotive force (EMF.). of	**LC, LW**

	the EMF source. Ohm's law for a homogeneous, inhomogeneous section of the circuit, for a closed circuit. The Kirchhoff rules. Ohm's laws and Kirchhoff's rules for direct current. Electric and magnetic fields, currents and electromagnetic fields. The total resistance (impedance) in electrical circuits. Ohm's law for alternating current and voltage. Diathermy. UHF therapy. Microwave therapy. Physical foundations of rheography and its application in medicine.	
Optics	Geometric optics. The phenomenon of total internal reflection of light. Refractometry. Fiber optics. The eye is an optical system. Microscopy. Wave optics. Electromagnetic waves. The scale of electromagnetic waves. Energy characteristics of light fluxes: the flux of light radiation and the flux density (intensity). Diffraction grating. The resolution of optical devices and the eye. The polarization of light. Polarization microscopy. Polarimetry. The interaction of light with matter. Light scattering. Light absorption. The Booger-Lambert-Behr law.	**LC, LW**
Electromagnetic radiation of the optical range	Thermal radiation. Characteristics and laws of thermal radiation. The spectrum of black body radiation. The radiation of the Sun. Application of Kirchhoff's law for measuring brightness temperature. . Calculation of the radiation temperature based on the Stefan-Boltzmann law. Lasers and their application.	**LC, LW**
Atomic structure. EPR. NMR. Ionizing radiation.	Atomic structure. Nuclear force. Isotopes. Electronic paramagnetic resonance. Nuclear magnetic resonance. Principles of magnetic resonance imaging. Electron-positron tomography. Ultraviolet radiation and its application. X-ray radiation and its use in land management. Radioactive radiation. Detection and dosimetry of ionizing radiation	**LC, LW**

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENT

Table 6.1. Classroom equipment and technology support requirements

Classroom for Academic Activity Type	Classroom Equipment	Specialized educational/laboratory equipment, software and materials for the mastering of the discipline
Learning Lab	General Physics Lab is equipped with a set of specialized furniture, lab equipment and experimental set-up. (classrooms. 319, 325, 340).	Meter ruler, calipers, scales, micrometers, microscopes, sample small rigid bodies, mathematical pendulum, timers, audiometer, glycerin, electrocardiography simulator, optical lenses, light source, He-Ne laser, diffraction grating, Clement-Desormes' experimental set-up, ammeter, DC generator, ohmmeter, voltmeter, capillary phenomenon experimental set-up.

7. RESOURSES RECOMMENDED FOR COURSE STUDy

Main readings:

1. Samuel. J Ling, Jeff Sanny, William Moebs (2016), "**University Physics Vol 1**", Openstax, Rice University, .
2. Samuel. J Ling, Jeff Sanny, William Moebs (2016), "**University Physics Vol 2**", Openstax, Rice University, .
3. Radj Kumar, G.L. Mittal (1997), "Physics", Nageen Prakasham, Meerut.
4. Tom Duncan, Heather Kennett, (2014) "**Cambridge IGCSE Physics Third Edition**", Hodder Education, an Hachette UK Company.
5. Ahmed Mohammed (2008)," **Physics for Medical Students**", Wheatmark, 610 East Delano Street, suite 104, Tucsun, Arisona 85705 U.S.A.
6. Karnilovich S. P., Yahya Shaar, "**The process of solving problems in physics**". Study guide for foreign students of RUDN and abroad. M.: RUDN, 2019. p.64

***Additional readings*:**

1. V.M. Yavorsky, A.A. Pinsky. Fundamentals of Physics. -M .: Nauka, 2007.V..

2. N.I. Golovtsov, I.M. Kashirsky, A.P. Loginov, N.A. Kovalchukov, A.K. Nikitin, T.A.

3. Ryzhov. Tasks in physics. –M.: Publishing house of RUDN University, 2008. - 159c.2.

4. Konev S.V., Volotovsky I.D. Photobiology // Minsk: BSU, 1974 - 285 p.

5. Nerpin S.V., Chudnovsky A.F. Energy and mass transfer in the system "plant-soil-air" // L .:

6. Hydrometeoizdat, 1975. - 358 s.

7. Vladimirov Yu.A. and others. Biophysics // M .: Medicine, 1991 - 427 c.

c) **software:** OC MS Windows (XP и выше), MS Office 2010, Mentor, TUIS.

Electronic full-text materials:

1. «Soros Educational Journal» - http://www . issep . rssi .ru
2. Project "Ramler-science" - natural sciences - http://www . nature .ru 3. Electronic version of the journal "Science" - http://www . sciencemag .org

* - All teaching materials for self-studding of students are placed in accordance with the current procedure on the discipline page in the RUDN LMS TUIS.

8.EVALUATION TOOLKIT AND GRADE SYSTEM FOR ASSESSMENT

Evaluation Toolkit (ET) and a point-rating system (PRS)* for assessment the level of competence formation (GPC-8) based on the results of mastering the discipline " **Physics**" are presented in the Appendix to this Work Program of the discipline.
* - ET and PRS are formed on the basis of the requirements of the relevant local regulatory act of the RUDN

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