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ФИО: Ястребов Олег Александрович
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**Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
(RUDN University)**

Agrarian Technological Institute
(Educational Division)

COURSE SYLLABUS

Inorganic and Analytical Chemistry
(Course title)

**Recommended by the Didactic Council for the Education Field of (Linguistics) for the
direction of training (specialty):**

35.05.01 Veterenary
(code and direction of training/specialty)

**The development of the course is carried out within the framework of the implementation of
the main professional educational program of higher education (EP of HE):**

Veterenary
(program (profile / specialisation) EP of HE)

2024 г.

35.05.01 Veterinary

1. Course Goals

The purpose of studying the course "Inorganic and Analytical Chemistry" is to form system knowledge about the structure of a substance, the main laws governing chemical reactions, patterns in the chemical behavior of the main classes of inorganic compounds in conjunction with their structure for using this knowledge as a basis for studying processes occurring in a living organism, and basic materials used in dental practice.

2. Requirements to Learning Outcomes the Course

The course " Inorganic and Analytical Chemistry" is expected to contribute to the following generic (GC) and generic professional competences (GPC) development as required by the Russian Higher Educational Standard for Training in Chemistry: **GC-6, GPC-3**

Table 2.1. List of competencies that form during studying the course (learning outcomes)

Competence code	Competence	Indicators of Competence Formation / Development
GC-6	Able to determine and implement the priorities of their own activities and ways to improve it on the basis of self-assessment and lifelong education.	GC -6.1. Evaluates own resources and their limits (personal, situational, temporary), uses them optimally for the successful completion of the task.
GPC-3	Capable of counteracting the use of doping in sports and the fight against it.	GPC-3.2. Understands the effect of the main types of doping on the physical qualities of a person, their side effects.

3. Course in Higher Education

The course "Inorganic and Analytical Chemistry" refers to the basic part of block 1 educational program of higher education.

As part of the EP of HE, students also study other courses and / or practices that contribute to the achievement of the planned results of studying the course " Inorganic and Analytical Chemistry".

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

Competence code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
GC-8	The ability to create and maintain safe living conditions in everyday life and in professional activities to preserve the natural environment, ensure the sustainable development of society, including in the event of a threat and the occurrence of emergencies and military conflicts	-	Biological Chemistry - Oral Biochemistry Pharmacology Organic chemistry Physical and colloidal chemistry Life safety Veterinary microbiology and mycology Virology and biotechnology Animal hygiene

Competence code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
			Veterinary pharmacology Veterinary sanitation Organic chemistry Physical and colloidal chemistry Life safety Veterinary microbiology and mycology Virology and biotechnology Animal hygiene Veterinary pharmacology Veterinary sanitation
GPC-4	The ability to use in professional activities methods of solving problems using modern equipment in the development of new technologies and to use modern professional methodology for conducting experimental studies and interpreting their results. The ability to use in professional activities methods of solving problems using modern equipment in the development of new technologies and to use modern professional methodology for conducting experimental studies and interpreting their results.	-	Organic chemistry Physical and colloidal chemistry Life safety Veterinary microbiology and mycology Virology and biotechnology Animal hygiene Veterinary pharmacology Veterinary sanitation
PC-7	The ability to select the necessary drugs of a chemical and biological nature for the treatment of animals, taking into account their cumulative pharmacological effect on the body The ability to select the necessary drugs of a chemical and biological nature for the treatment of animals, taking into account their cumulative pharmacological effect on the body	-	Organic chemistry Physical and colloidal chemistry Life safety Veterinary microbiology and mycology Virology and biotechnology Animal hygiene Veterinary pharmacology Veterinary sanitation Organic chemistry Physical and colloidal chemistry Life safety

Competence code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
			Veterinary microbiology and mycology Virology and biotechnology Animal hygiene Veterinary pharmacology Veterinary sanitation

4. Course Workload and Training Activities

Course workload "Chemistry" is 3 credits.

Table 4.1. Types of academic activities during the period of the HE program(me) mastering

Types of academic activities	Total academic hours	Semester(s)			
		1	2	3	4
<i>Contact academic hours</i>	51	51			
including:					
Lectures (L)	17	17			
Lab works (LW)	34	34			
Seminars (workshops/tutorials) (S)	-	-			
<i>Self-study (ies), academic hours</i>	35	35			
<i>Evaluation and assessment (exam or pass/fail grading), academic hours</i>	22	22			
Course workload	academic hours	108	108		
	credits	3	3		

5. Course Modules and Contents

Table 5.1. Contents of course by type of academic activities

Modules	Contents of Modules	Type of academic activities
Classes of inorganic compounds	Main classes of inorganic compounds. Double oxides. Ceramic materials.	LW
Basic concepts of thermodynamics. First and second laws of thermodynamics.	Subject and methods of chemical thermodynamics. The relationship between the processes of metabolism and energy in the body. Chemical bioenergetics. Basic concepts of thermodynamics. Intensive and extensive parameters. State function. Internal energy. Work and heat are two forms of energy transfer. Types of thermodynamic systems (isolated, open, closed). Types of thermodynamic processes (isothermal, isobaric). Standard state. First law of thermodynamics. Enthalpy. Standard enthalpies of formation and combustion of a substance. Standard enthalpy of reactions. Hess' law.	L, LW

	<p>Application of the first law of thermodynamic to biosystems. The second law of thermodynamics. Reversible and irreversible processes. Entropy. Gibbs energy. Forecasting the direction of spontaneous processes in isolated and closed systems; the role of enthalpy and entropy factors. Thermodynamic equilibrium conditions. Standard Gibbs energies of formation and biological oxidation of matter. Standard Gibbs energy of the reaction. Examples of exergonic and endergonic processes occurring in the body. The principle of energy conjugation.</p>	
<p>Basic concepts of chemical kinetics. Classification of reactions in kinetics.</p>	<p>Chemical balance. Reversible and irreversible reactions. Thermodynamic equilibrium conditions in isolated and closed systems. Chemical equilibrium constant. The equation of the isotherm and isobar of a chemical reaction. Subject and basic concepts of chemical kinetics. Chemical kinetics as a basis for studying the rates and mechanisms of biochemical processes. Average speed and true speed. Classification of reactions in kinetics: homogeneous, heterogeneous, simple and complex reactions. Molecularity of the elementary act of the reaction. Kinetic equations. Reaction order. half-life. Dependence of reaction rate on concentration. Kinetic equations of zero, first, second order reactions. Experimental methods for determining the rate and rate constant of reactions. The dependence of the reaction rate on temperature. The temperature coefficient of the reaction rate and its features for biochemical processes. The concept of the theory of active collisions. Activation energy. Arrhenius equation; the role of the steric factor. The concept of the theory of the transition state. Catalysis. Homogeneous and heterogeneous catalysis. Energy profile of the catalytic reaction. Features of the catalytic activity of enzymes. Michaelis-Menten equation and its analysis.</p>	L, LW
<p>Concentrations and colligative properties of solutions.</p>	<p>Classification of solutions. Methods for expressing the concentrations of solutions. Volumetric analysis. Titration. Raoult's law, cryoscopy, ebullioscopy, Van't Hoff's law, isotonic, hyper-, hypotonic solutions.</p>	LW
<p>Ionic equilibrium in electrolyte solutions.</p>	<p>Proton theory of Lewis acids and bases. Acidity, basicity constants, the relationship between the acidity and basicity constant in a conjugated protolytic pair, the general constant of the combined protolytic equilibrium. Protolytic processes occurring in the oral cavity, their effect on hard dental tissues. Ionic product of water, pH of solutions; hydrolysis of salts, degree and constant of hydrolysis. Hydrolysis of food products in the oral cavity and its effect on hard dental tissues. buffer solutions. hydrolysis of starch. Ampholytes. Acidity of gastric juice. The role of pH in body fluids. Solubility constant. General constant of combined heterogeneous equilibrium. Conditions for the formation and dissolution of precipitates. The phenomenon of isomorphism.</p>	L, LW

Reactions of complexing	Werner's coordination theory. The nature of the chemical bond in complex compounds. Classification of complex compounds. Nomenclature of complex compounds. Polydentate ligands. Chelation. The structure of hemoglobin, chlorophyll. Stability of complex compounds in solutions. Complex instability constant. Toxic effect of salts of heavy metals. Antidotes.	LW
Disperse systems	Classification of dispersed systems. Classification of dispersed systems according to the degree of dispersion; according to the state of aggregation; according to the strength of intermolecular interaction between the dispersed phase and the dispersion medium. The nature of the colloidal state. Obtaining and properties of dispersed systems. Obtaining suspensions, emulsions, colloidal solutions. Dialysis, electro dialysis, ultrafiltration. Molecular-kinetic properties of colloidal dispersed systems: Brownian motion, diffusion, osmotic pressure, sedimentation equilibrium. Optical properties: light scattering (Rayleigh's Law). Electrokinetic properties: electrophoresis and electroosmosis; flow potential and sedimentation potential. The structure of the electrical double layer. Electrokinetic potential and its dependence on various factors. Stability of dispersed systems. Sedimentation, aggregation and condensation stability of lyosols. Factors affecting the stability of lyosols. Coagulation. Coagulation threshold and its definition, Schulze-Hardy rule, habituation phenomenon. mutual coagulation. The concept of modern theories of coagulation. Colloidal protection and peptization. Colloidal surfactants; biologically important colloidal surfactants (soaps, detergents, bile acids). Micellization in surfactant solutions. Determination of the critical micelle concentration. Liposomes.	L, LW
Electrochemical processes and redox reactions.	The theory of redox processes. The concept of redox systems. Standard redox potentials. The occurrence of EMF in the oral cavity during metal prosthetics. The appearance of a double electric layer at the metal-electrolyte interface. Electrode potential, methods of its measurement. Electrochemical series of voltages of metals. The principle of operation of galvanic cells. Dental materials. Their classification, brief description, application in dentistry. Basic (structural) dental materials: metals and alloys, polymers, ceramics. Corrosion of metals, its types. Electrochemical corrosion: conditions of occurrence; factors contributing to its flow in the oral cavity during metal prosthetics.	L, LW

6. Classroom Equipment and Technology Support Requirements

Table 6.1. Classroom Infrastructure and Technology Support Requirements

Classroom for Academic Activity Type	Classroom Equipment	Specialized Educational / Laboratory Equipment, Software and Materials for Studying the Course
Laboratories of the Department of General Chemistry of the Faculty of Physics, Mathematics and Natural Sciences	Classroom for lab works, equipped with a set of specialized furniture	A set of specialized furniture, reagent kits, stands, chemical glassware (test tubes, cups, flasks, pipettes, burettes), D.I. Mendeleev's table, activity series of metals, solubility table, marker board, markers, sponge, fume hood, centrifuge, photocalorimeters, potentiometers, analytical balances, multimedia systems.
For self-studies	Classroom for seminar-type classes, self-studies, group and individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and multimedia equipment	A set of devices includes portable multimedia projector, laptop, projection screen, stable wireless

7. Recommended Sources for Course Studies

a) Main reading (sources)

- Harper's Illustrated Biochemistry: textbook / Rodwell V. W., Bender D. A., Botham K. M., Kennelly P. J., Weil P. A. - United States: McGraw Hill Education, 2015 - 817 p. - 30-th Edition.
- Brown T, LeMay H., Bursten B. et al. Chemistry: The Central Science. 14th Edition. - Pearson, 2017 – 1248 p.
- Sharma R.K. Textbook of Coordination Chemistry.-New Delhi: Discovery Publishing House, 2007 – 285p.
- Charles E Carraher Jr. Introduction to Polimer Chemistry. 4th Edition - CRC Press, 2017 – 588 p.
- Kovalchukova O.V Lectures on general and bioorganic chemistry. Part 1. General chemistry. M.: Publishing house RUDN, 2011.
- Kovalchukova O.V, Avramenko O.V Lectures on general and bioorganic chemistry. Part 2. Bioorganic chemistry. M.: Publishing house of RUDN, 2010.
- Langdon J. Physical Chemistry: Theories, Models and Applications. - NY RESEARCH PRESS, 2018 – 246 p.

b) Optional sources:

- Geoffrey A. Lawrance. Introduction to Coordination. A Wiley Series of Advanced Texbooks.- NSW, Australia, 2010 -304 p.
- David R. Klein. Organic Chemistry. 1sh Edition. Wiley, 2011 – 1392 p.
- Kovalchukova O.V., Avramenko O.V., Vu Thi Nkog An The theoretical foundations of the

course "Chemistry". М .: Publishing house of RUDN,2018.

- Nivaldo Tro. Chemistry: A Molecular Approach. 5th Edition. – Pearson, 2019 – 1320 p.

c) *List of educational and electronic materials:*

- <https://esystem.rudn.ru/>

Internet-(based) sources:

1. Electronic libraries with access for RUDN students:

- Electronic libraries of RUDN <http://lib.rudn.ru/MegaPro/Web>
- ELS «University Library Online» <http://www.biblioclub.ru>
- ELS Юрайт <http://www.biblio-online.ru>
- ELS «Student Advisor» www.studentlibrary.ru
- ЭБС «Лань» <http://e.lanbook.com/>

8. Assessment and Evaluation Toolkit

Mid-term assessment and evaluation toolkit and assessment and marking/grading criteria based on the results of studying the course "Chemistry" are presented in the Appendix to this Course syllabus.

Authors:

**Senior Lecturer of the General
and Inorganic Chemistry
Department**

Nevskaya A.A.

Assignment

Signature

**The Department of the General
and Inorganic Chemistry**

Khrustalyov V.N.

Department

Signature

HEAD OF HIGHER EDUCATION PROGRAMME:

Director of the Department of Veterinary Medicine

Position, Basic curriculum

Signature

Vatnikov Yu.A.

Full name