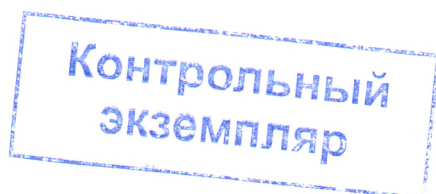


MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS
Educational Institution
BELARUSIAN STATE MEDICAL UNIVERSITY



APPROVED

by Rector of the Educational
Institution «Belarusian State
Medical University»

S.P. Rubnikovich

Reg. # UD-091-097/2425/edu.



PHYSICAL AND COLLOID CHEMISTRY

**Curriculum of the educational institution
in the academic discipline for the specialty**

7-07-0912-01 «Pharmacy»

Curriculum is based on the educational program «Physical and Colloid Chemistry», approved 26.06.2024, registration # УД-091-097/2425/уч.; on the educational plan in the specialty 7-07-0912-01 «Pharmacy», approved 15.05.2024, registration #7-07-0912-01/2425/mf.

COMPILERS:

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RECOMMENDED FOR APPROVAL:

by the Department of General Chemistry of the Educational Institution «Belarusian State Medical University»
(protocol # 6 of 22.05.2024);

by the Scientific and Methodical Council of the Educational Institution «Belarusian State Medical University»
(protocol # 18 of 26.06.2024)

EXPLANATORY NOTE

«Physical and Colloid Chemistry» is the academic discipline of the Chemical Module containing systematized scientific knowledge on properties of different systems and regularities of physical and chemical processes in them, that studies interconnections between chemical processes and physical events accompanying them.

The aim of the academic discipline «Physical and Colloid Chemistry» is the formation of basic professional competencies that are necessary for understanding basic regularities of different processes.

The objectives of the academic discipline «Physical and Colloid Chemistry» are to form students' scientific knowledge about fundamental laws and theories of physical and colloid chemistry, skills and abilities needed to conduct a chemical experiment and to solve practical problems in professional activity.

The knowledge, skills, and abilities acquired during the study of the academic discipline «Physical and Colloid Chemistry» are necessary for successful mastering of the following modules: «Pharmaceutical Technology», «Pharmaceutical Chemistry and Pharmacognosy».

Studying the educational discipline «Physical and Colloid Chemistry» should ensure the formation of students' basic professional competency: apply knowledge of the basic physical, chemical and biological laws for quality control of medicines and medicinal plant raw materials.

As a result of studying the academic discipline «Physical and Colloid Chemistry» the student should

know:

basic concepts and laws of physical and colloid chemistry;
the role and significance of physical and colloid chemistry methods in pharmacy;

basics of chemical thermodynamics, chemical and phase equilibria;
properties of nonelectrolytes and electrolytes;
electrochemical processes and methods used in medicine and pharmacy;
basics of chemical kinetics and catalysis;
applications of adsorption and other surface phenomena in pharmacy;
properties of colloid solutions;
dispersed systems used as medicines;
methods of obtaining and usage of biopolymers in pharmacy;

be able to:

work with main types of equipment used in physical and colloid chemistry;
process, analyze and generalize the data of physical and chemical observations and measurements;

master:

safety fundamentals and basic approaches and methods of physical and chemical experiments conduction;
skills of production of buffer and colloid solutions, solutions of biopolymers.

Total number of hours for the study of the discipline is 220 academic hours. Classroom hours according to the types of studies: lectures – 15 hours (including 3

hours of supervised student independent work), laboratory studies – 111 hours, student independent work (self-study) – 93 hours.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of a credit (3rd semester) and exam (4th semester).

Form of higher education – full-time.

ALLOCATION OF ACADEMIC TIME ACCORDING TO SEMESTERS OF STUDY

Code, name of the specialty	Semester	Number of academic hours						Form of intermediate assessment
		total	in-class	including			out-of-class self-studies	
				lectures	supervised student independent work	laboratory studies		
7-07-0912-01 «Pharmacy»	3	110	63	6	-	57	47	credit
	4	110	63	6	3	54	47	examination
		220	126	12	3	111	94	

THEMATIC PLAN

Section (topic) name	Number of class hours	
	lectures	laboratory
1. Physical Chemistry	9	78
1.1. Main concepts and laws of thermodynamics. Thermodynamics of chemical equilibrium	3	18
1.2. Thermodynamics of phase transitions	1,5	15
1.3. Kinetics of chemical reactions and catalysis	-	12
1.4. Properties of dilute solutions of nonelectrolytes and electrolytes	1,5	12
1.5. Electrochemistry	1,5	9
1.6. Physical and chemical basics of surface phenomena	1,5	12
2. Colloid Chemistry	6	33
2.1. Dispersed systems. Production, purification, properties, stability and coagulation of colloid solutions	1,5	15
2.2. Different types of colloid systems	3	6
2.3. Biopolymers and their solutions	1,5	12
Total hours	15	111

CONTENT OF THE EDUCATIONAL MATERIAL

1. Physical Chemistry

1.1. Main concepts and laws of chemical thermodynamics.

Thermodynamics of chemical equilibrium

The history of physical chemistry development. The place of physical chemistry among other scientific disciplines and its impact into the development of pharmacy.

Aims and methods of thermodynamics. Main concepts and definitions: systems, states of systems, processes, functions of a state and functions of a process. Internal energy. Work. Heat.

The first law of thermodynamics. Wordings and mathematical expression of the first law of thermodynamics. Enthalpy. Isochoric and isobaric heat of a process, connection between them. Hess's law. Thermochemical equations. Standard enthalpies of formation and combustion of substances and their usage in thermochemical calculations. The heat of neutralization, the heat of the dissolving, the heat of hydration. Enthalpic diagrams. The dependence of heat effect on the temperature. Kirchhoff's equation.

The second law of thermodynamics. Reversible and irreversible processes from the point of view of thermodynamics. Wordings and mathematical expression of the second law of thermodynamics. Maximal heat of a process. Useful work. Entropy. Calculation of the change of entropy in isolated systems, in isothermal processes, due to the change in temperature. Statistical nature of the second law of thermodynamics. Connection of entropy with thermodynamic probability of the state of a system. Boltzmann's entropy formula.

The third law of thermodynamics. Absolute entropy. Standard entropies of solid, liquid and gaseous substances. The usage of standard entropies for the calculation of the standard entropy of a chemical reaction.

Thermodynamic potentials. Helmholtz energy, Gibbs energy, connection between them. The change of Helmholtz and Gibbs free energies in spontaneous processes. The concept of chemical potential.

Thermodynamic characteristics of the state of chemical equilibrium. Constant of chemical equilibrium and different ways to express it. Equation of the isotherm of a chemical reaction. Equations of the isobar and the isochore of a chemical reaction. Consequences of those two equations and their connection with Le Chatelier-Braun principle. Calculation of the constant of chemical equilibrium from the table of standard thermodynamic values. Plotting of van't Hoff isobar. Application of laws of thermodynamics to molecular docking in the process of the design of new biologically active compounds.

1.2. Thermodynamics of phase transitions

Main concepts: homogeneous and heterogeneous systems, the phase, substances and components of a system. The number of independent components of a system, the number of the degrees of freedom. Gibbs phase rule. Phase transitions and equilibria: evaporation, sublimation, melting, the change of allotropic modification. Equations of Clapeyron and Clausius-Clapeyron, their connection with

the Le Chatelier-Braun principle.

Unicomponent systems. Phase diagram of water as a sample of phase diagrams for unicomponent systems. Phase diagram of sulfur, carbon, carbon dioxide.

Bicomponent (binary) systems. Concept on physical and chemical analysis, its application to study medicines. Thermal analysis. Cooling curves. Melting diagram for binary systems with unlimited solubility of components in liquid state and mutual insolubility in the solid state. Application of Gibbs phase rule for the analysis of phase diagrams.

Solubility of liquids in liquids. Ideal and real solutions. Saturated vapor pressure upon a solution. Raoult's law. Types of diagrams: «vapor pressure – content», «temperature of boiling – content». The first law of Konovalov. Deviations from Raoult's law. Azeotropes. The second law of Konovalov. Simple and fractional distillation. Concept on rectification. Liquids with limited solubility. Higher and lower critical temperatures of the dissolving. Immiscible liquids. Theoretical basics of the distillation with water vapor.

Tricomponent systems. Phase diagrams for tricomponent systems. The law of distribution by Nernst. The coefficient of distribution. Extraction. Principles of tinctures and decoctions production.

1.3. Kinetics of chemical reactions and catalysis

Subject of chemical kinetics and its importance for pharmacy. Main concepts: simple and multistep reactions, homogeneous and heterogeneous reactions. The rate of chemical reaction and methods to determine it. Dependence of the rate of a chemical reaction on different factors. The law of mass action. The order and the molecularity of a chemical reaction. Kinetic equations of zeroth, First, and second order processes. Half-elimination period. Methods to determine the order of a chemical reaction. Dependence of the rate of a chemical reaction on temperature. The rule of van't Hoff. Temperature coefficient of the rate of a chemical reaction. Express methods to check the best before time for medicines. Arrhenius equation. Basics of the theory of active collisions. Activation energy. Dependence between the rate of a chemical reaction and the activation energy. Steric factor. Methods to determine the activation energy. Basics of the theory of transition state (activated complex). Comparative analysis of the Arrhenius equation and the equation of the transition state complex theory. Concepts on methods to study and model transition state complex.

Multistep reactions: reversible, parallel, consequent, conjugated. Metabolization of a medicine in the organism as the set of consequent processes, constant of absorption and constant of elimination. Chain reactions. Stages of a chain reaction. Nonbranched and branched chain reactions. Photochemical reactions. The law of photochemical equivalence by Einstein.

Characteristic features of heterogeneous reactions. The rate of a heterogeneous reaction. Kinetic and diffuse areas of heterogeneous processes. Factors determining the rate of a heterogeneous reaction.

Catalysis. Positive and negative, homogeneous and heterogeneous catalysis. The mechanism of action for a catalyst during homogeneous catalysis. Activation energy of catalytic reactions. Acid-base catalysis in solutions. Metal-complex

catalysis. Enzymatic catalysis and characteristic features of enzymes as catalysts. Inhibition of chemical reactions. Inhibitors. Kinetic way to determine the activity of an enzyme in a sample.

1.4. Properties of dilute solutions of nonelectrolytes and electrolytes

Colligative properties of solutions: relative decrease of saturated vapor pressure upon a solution, freezing temperature depression, boiling temperature elevation, and osmotic pressure of dilute solutions of nonelectrolytes. Cryoscopic and ebullioscopic constants, their connection with heat effect and temperatures of freezing and boiling of a solvent.

Colligative properties of solutions of electrolytes. Isotonic coefficient.

Cryometric, ebulliometric, and osmometric methods of molar mass and isotonic coefficient determination.

Solubility of gases in liquids. Thermodynamics of the dissolving. The law of Henry. Equation of Sechenov.

Theory of strong electrolytes solutions by Debye and Huckel. The concept of ionic atmospheres. Activity of ions and its connection with concentration. Coefficient of activity. Ionic strength of a solution. Limiting law of Debye-Huckel.

Ionization of water. Ionic product of water. Hydrogen index (pH).

Buffer systems and solutions. Content, mechanism of action and calculation of pH for acetic, phosphate, ammonia and bicarbonate buffer solutions. Buffer capacity and factors on which it depends on. Importance of buffer systems for chemistry, biology, and pharmacy.

1.5. Electrochemistry

The concept of electric conductivity. Conductors of the first and second order. Specific and molar electric conductivities of solutions of electrolytes, factors that influence their values. Limiting molar electroconductivity (at maximal dilution). The speed of movement and mobility of ions. The law of Kohlrausch (the law of independent movement of ions). Electric conductivity of nonaqueous solutions.

Conductometry, conductometric determination of the degree and the constant of ionization for a weak electrolyte, of the electroconductivity coefficient for a strong electrolyte, of the solubility of hardly soluble electrolytes. Conductometric titration.

Electrode potentials. Mechanism of the occurrence of a dielectric layer on the border between metal and solution. Nernst equation. Standard electrode potentials. Classification of electrodes. Standard hydrogen electrode. Silver chloride electrode as a representative of electrodes of the second order. Redox electrodes and mechanism of potential occurrence upon them. Nernst-Peters equation. Standard and formal redox potential of biological redox systems. Ion selective electrodes. Glass electrode. Construction of pH-meter.

Galvanic elements: chemical and concentrative. Calculation of electro motive force in galvanic elements.

Potentiometry, potentiometric method to measure pH. Potentiometric titration. Application of potentiometry in biology, medicine, and pharmacy.

1.6. Physical and chemical basics of surface phenomena

Surface phenomena and their significance for pharmacy. Surface Gibbs free energy and surface tension. Methods of surface tension determination. Dependence of

surface tension on different factors. Surface activity. Surface active substances (SAS), surface inactive substances (SIS), surface nonactive substances (SNS). Ducklo-Traube rule. Isotherm of surface tension. Shishkovsky equation.

Concept of wetting. Wetting angle. Yung equation. Enthalpy of wetting and coefficient of hydrophilicity.

Adsorption on mobile surface of contact between phases (liquid and gas, liquid and liquid). Gibbs isotherm of adsorption equation. Orientation of SAS molecules in the superficial layer. Determination of the area occupied by a molecule of SAS in the saturated adsorption layer, as well as the maximal length of SAS.

Adsorption on solid sorbents. Estimation of adsorption on the border between solid and gas, and between solid and liquid. Factors influencing adsorption of gases and solutes. Main statements of monomolecular adsorption theory and equation of Langmuir adsorption isotherm. Equation of Freundlich adsorption isotherm. Determination of constants in equations of Langmuir and Freundlich from experimental data. Polymolecular adsorption. Basics of enzyme-linked immunosorbent assay. Capillary condensation, absorption, chemisorption.

Adsorption of electrolytes from their solutions. Equivalent and selective adsorption of ions. Fajans-Paneth rule. Ion-exchange adsorption. Ionites and their classification. Exchange capacity. Application of ionites in pharmacy.

Conception of physical and chemical basics of different groups of chromatography methods of analysis: high pressure liquid chromatography, gas chromatography, ion-exchange chromatography, size-exclusion chromatography, affine chromatography. Concept of mass-spectrometry.

2. Colloid Chemistry

2.1. Dispersed systems. Production, purification, properties, stability and coagulation of colloid solutions

History of colloid chemistry development. Importance of colloid chemistry for pharmacy.

Structure of dispersed systems. Dispersed phase, dispersed medium. Dispersion degree.

Classification of dispersed systems by the aggregation state of dispersed phase and dispersed medium, by the type of interactions between dispersed phase and dispersed medium, by the mobility of dispersed phase.

Methods of production and purification of colloid solutions (filtration, dialysis, electrodialysis, ultrafiltration).

The nature of electric events in dispersed systems. Mechanism of occurrence of electric charge upon colloid particles. Structure of dielectric layer. Micelle, the structure of the micelle of a sol. The charge, electrothermodynamical and electrokinetical potentials of a colloid particle. The influence of electrolytes on electrokinetical potential. Phenomenon of colloid particles recharging.

Electrokinetical events. Electrophoresis. Electroosmosis. Connection between the speed of colloid particles electrophoresis and electroosmosis with electrokinetical potential of colloid particles (Helmholtz-Smoluchovsky equation). Electrophoretic mobility. Practical application of electrophoresis and electroosmosis in pharmacy. Potential of sedimentation and potential of streaming.

Brownian motion, diffusion, osmotic pressure. Sedimentation. Sedimentation stability and sedimentation equilibrium. Centrifugation as the method to study colloid systems. Sedimentation analysis.

Light scattering and light absorption. Rayleigh equation. Nephelometry. Ultramicroscopy and electron microscopy of colloid systems. Determination of a shape, size, and mass of colloid particles.

Kinetic and aggregative stability of colloid systems. Factors of stability. Coagulation and factors that can cause it. Slow and fast coagulation. Coagulation threshold and its determination. The rule of Schulze and Hardy. Alternation of coagulation areas. Coagulation of sols by mixtures of electrolytes. Additivity, antagonism and synergy of ions during the coagulation by mixtures of electrolytes. Colloid protection.

Theories of coagulation. Adsorption theory of Freundlich. Theory of Deryagin-Landau-Ferway-Overbeck.

2.2. Different types of colloid systems

Aerosols: methods of obtaining, molecular kinetic, optical and electrokinetic properties. Aggregative stability of aerosols and factors that determine it. Destruction of aerosols. Application of aerosols in pharmacy. Photophoresis and thermophoresis.

Powders and their properties. Caking, granulation and sprayability of powders. Application of powders in pharmacy.

Suspensions: methods of production, molecular kinetic, optical and electrokinetic properties. Stability of suspensions and factors that determine it. Flocculation. Sedimentation analysis of suspensions. Foams. Pastes.

Emulsions. Types of emulsions. Emulsifiers and mechanisms of their action. Conversion of emulsion phases. Stability of emulsions and its disturbance. Factors determining stability of emulsions. Coalescence. Properties of concentrated and highly concentrated emulsions. Application of suspensions and emulsions in pharmacy.

Micellar colloid systems formed by surface active substances: solutions of soap, detergents, dyes. Formation of micelles in solutions of SAS. Critical micelle concentration and its determination. Solubilization and its importance for pharmacy. Micellar colloid systems in pharmacy.

2.3. Biopolymers and their solutions

Methods of production of biopolymers. Classification of biopolymers. Flexibility of chains of biopolymers. Internal rotation of subunits in chains of biopolymers. Crystal and amorphous states of biopolymers. Thermodynamics of folding of proteins and nucleic acids.

Swelling and dissolving of biopolymers. The mechanism of swelling. Thermodynamics of swelling and dissolving of biopolymers. Influence of different factors on the swelling degree. Lyotropic series of ions.

Viscosity of biopolymers solutions. Deviations of properties of biopolymers solutions from laws of Newton and Poiseuille. Causes of abnormal viscosity of solutions of biopolymers. Relative, specific, reduced, characteristic viscosity. Staudinger equation and its modification. Estimation of average molecular mass of a biopolymer with the help of viscosimetry method.

Polymeric nonelectrolytes and polyelectrolytes. Polyampholytes. Isoelectric point of polyampholytes and methods to determine it.

Osmotic properties of biopolymers solutions. Osmotic pressure of polymeric nonelectrolytes solutions. Deviations from van't Hoff's law. Equation of Geller. Estimation of molar mass of polymeric nonelectrolytes. Poly electrolytes. Osmotic pressure of poly electrolytes. Membrane equilibrium of Donnan.

Factors of stability for solutions of biopolymers. Salting out, salting out thresholds. Dependence of salting out thresholds of poly ampholytes on pH of a medium. Coacervation. Microcoacervation. Microcapsulation. Gelatination. Influence of different factors on the speed of gelatination. Tixotropy of jellies and gels. Syneresis of jellies. Diffusion and periodic reactions in jellies and gels. Concept of electrophoresis of proteins in polyacrylamide gel.

EDUCATIONAL DISCIPLINE «PHYSICAL AND COLLOID CHEMISTRY» CURRICULAR CHART

Section, topic #	Section (topic) name	Number of class hours		Supervised student independent work	Literature	Practical skills	Form of control	
		lectures	laboratory				of practical skills	of current / intermediate assessment
3 semester								
	Lectures	6	-	-				
1.	The first law of thermodynamics, Kirchhoff's law	1,5	-	-	1-5			
2.	The second and third laws of thermodynamics, thermodynamics of chemical equilibrium	1,5	-	-	1-5			
3.	Thermodynamics of phase equilibria, state diagrams	1,5	-	-	1-5			
4.	Thermodynamics of solutions	1,5	-	-	1-5			
	Laboratory lessons	-	57	-				
1.	Basic concepts and laws of thermodynamics: the first law of thermodynamics. Lab work: «Determination of the thermostat-calorimeter constant»	-	3	-	1-5			Control work
2.	Basic Concepts and Laws of Thermodynamics: Hess's Law. Lab work: «Determination of the heat of neutralization reaction of a strong acid with a strong base»	-	3	-	1-5			Control work
3.	Basic concepts and laws of thermodynamics: Kirchhoff's Law. Lab work: «Calculation of the heat of	-	3	-	1-5			Control work

	dissociation of a weak electrolyte»							
4.	Basic concepts and laws of thermodynamics: the second law of thermodynamics. Lab work: «Determination of the heat of dissolution of anhydrous copper sulfate salt»	-	3	-	1-5	Determination of the heat of salt dissolution, heat of neutralization	Laboratory work report	Control work
5.	Basic concepts and laws of thermodynamics: the third law of thermodynamics, absolute entropy. Lab work: «Calculation of the heat of hydration»)	-	3	-	1-5	Determination of the equilibrium constant of a homogeneous reaction	Laboratory work report	Control work
6.	Thermodynamics of chemical equilibrium. Lab work: «Calculation of enthalpy and entropy using the van 't Hoff equation»	-	3	-	1-5	Determination of the equilibrium constant of a homogeneous reaction	Laboratory work report	Control work
7.	Thermodynamics of phase equilibria: One-component systems. Lab work: «Determination of the melting point of diphenylamine and naphthalene»	-	3	-	1-5			Case study
8.	Thermodynamics of phase equilibria: melting diagrams of two-component systems. Lab work: «Construction of the melting point diagram of the diphenylamine-naphthalene binary system», part 1	-	3	-	1-5			Case study
9.	Thermodynamics of phase equilibria: boiling diagrams of two-component systems. Lab work: «Construction of the melting point diagram of the diphenylamine-naphthalene binary system», part 2	-	3	-	1-5	Construction of a state diagram for a two-component system	Laboratory work report	Case study
10.	Thermodynamics of phase equilibria: three-component systems. Lab work: «Determination of the distribution coefficient of acetic acid	-	3	-	1-5			Control work

	between an organic solvent and water»							
11.	Fundamentals of thermodynamics of phase transformations	-	3	-	1-5			Colloquium
12.	Chemical reaction kinetics and catalysis: reaction order, half-life. Lab work: «Determination of Reaction Order»	-	3	-	1-5			Control work
13.	Chemical reaction kinetics and catalysis: collision theory. Lab work: «Study of the kinetics of the saponification reaction of acetic acid ethyl ester with alkali»	-	3	-	1-5			Control work
14.	Chemical reaction kinetics and catalysis: transition state theory. Lab work: «Determination of the rate constant, activation energy, enthalpy and entropy of formation of the transition complex»	-	3	-	1-5	Determination of the rate constant for a chemical reaction	Laboratory work report	Express quiz during laboratory work
15.	Chemical reaction kinetics and catalysis: fundamentals of catalysis. Lab work: «Study of the influence of a catalyst on the rate of a chemical reaction»	-	3	-	1-5			Express quiz during laboratory work
16.	Properties of dilute solutions of non-electrolytes and electrolytes: solubility, Raoult's Laws. Lab work: «Influence of temperature on salt solubility»	-	3	-	1, 2			Control work
17.	Properties of dilute solutions of non-electrolytes and electrolytes: osmotic pressure. Lab work: «Cryoscopic determination of the molar mass of sucrose»	-	3	-				Control work
18.	Properties of dilute solutions of non-electrolytes and electrolytes: buffer	-	3	-	1, 2	1. Production of buffer solutions with certain pH.	Laboratory work report	Control work

	systems. Lab work: «Preparation of buffer solutions with a predetermined pH value and study of their properties»					2. Determination of the buffer capacity of the prepared buffer solution		
19.	Fundamentals of thermodynamics and kinetics of aqueous solutions	-	3	-	1-5			Colloquium. Credit
4 semester								
	Lectures	6	-	3				
1.	Electrochemistry: conductometry and potentiometry	1,5	-	-	1, 2			
2.	Surface phenomena: adsorption theories, physico-chemical fundamentals of chromatography	1,5	-	-	1, 2			
3.	Colloidal solutions: structure, stability, study methods	1,5	-	-	1, 2			
4.	Various classes of disperse systems	1,5	-	1,5	1, 2			Presentation of a report
5.	Micellar colloidal systems	1,5	-	1,5	1, 2			Preparation of didactic materials
6.	Physical chemistry of biopolymers and their solutions	1,5	-	-	1, 2			
	Laboratory lessons	6	-	3				
1.	Electrochemistry: conductometry. Lab work: «Conductometric determination of the degree and constant of dissociation of a weak electrolyte»	-	3	-	1, 2			Control work
2.	Electrochemistry: Conductometric Titration. Lab work: «Conductometric determination of zinc ion concentration in a solution»	-	3	-	1, 2	Conductometric titration of strong and weak acids and their mixture	Laboratory work report	Control work
3.	Electrochemistry: Potentiometry. Lab work: «Potentiometric determination of the activity coefficient of electrolytes»	-	3	-	1, 2	1. Measurement of pH of a solution by the potentiometric method. 2. Potentiometric titration	Laboratory work report	Control work

						of strong and weak acids. 3. Calculation of the potential of an oxidation-reduction electrode		
4.	Physico-chemical fundamentals of surface phenomena: adsorption at a mobile interface. Lab work: «Stalagmometric determination of the dependence of surface tension of solutions on the hydrocarbon chain length of surfactants»	-	3	-	1, 2			Control work
5.	Physico-chemical fundamentals of surface phenomena: adsorption at an immobile interface. Lab work: «Study of adsorption of a substance from a solution on a solid adsorbent»	-	3	-	1, 2			Control work
6.	Physico-chemical fundamentals of surface phenomena: chromatography. Lab work: «Separation of blood serum lipids by thin-layer chromatography»	-	3	-	1, 2			Case study
7.	Fundamentals of electrochemical and surface phenomena	-	3	-	1, 2			Colloquium
8.	Disperse systems: classification of disperse systems, structure of colloidal particles. Lab work: «Preparation of colloidal solutions by the condensation method»	-	3	-	1, 2			Control work
9.	Disperse systems: molecular-kinetic properties of colloidal solutions. Lab work: «Preparation of colloidal solutions by the peptization method»	-	3	-	1,2			Control work
10.	Disperse systems: optical properties of colloidal solutions. Lab work: «Obtaining transmission spectra	-	3	-	1,2			Control work

	of colloidal solutions»							
11.	Disperse systems: electrokinetic phenomena in colloidal solutions. Lab work: «Determination of the obtaining and determining coagulation thresholds of sols.coagulation threshold of a sol by electrolytes using a colorimetric method»	-	3	-	1, 2	Production and estimation of coagulation thresholds for sols	Laboratory work report	Control work
12.	Disperse systems: stability and coagulation of colloidal solutions. Lab work: «Protective action of gelatin on colloidal solutions»	-	3	-	1, 2			Control work
13.	Various classes of disperse systems: aerosols, powders, suspensions, emulsions. Lab work: «Preparation of emulsions and study of their properties»	-	3	-	1, 2	Preparation of emulsions and determination of their types	Laboratory work report	Express quiz during laboratory work
14.	Various classes of disperse systems: colloidal solutions of surfactants. Lab work: «Conductometric determination of the critical micelle concentration»	-	3	-	1, 2			Case study
15.	High-molecular compounds and their solutions: structure and classification, isoelectric point of biopolymers. Lab work: «Determination of the isoelectric point of a protein»	-	3	-	1, 2			Control work
16.	High-molecular compounds and their solutions: thermodynamics of biopolymer solutions. Lab work: «Determination of the dependence of gelatin swelling on the acidity of the medium. Precipitation of gelatin from solution by salting-out»	-	3	-	1,2			Control work
17.	High-molecular compounds and their solutions: osmotic pressure and viscosity in biopolymer solutions.	-	3	-	1, 2			Control work

	Lab work: «Determination of the molecular weight of polyglucin by viscometric method»							
18.	Fundamentals of physical chemistry of disperse systems and biopolymer solutions	-	3	-	1, 2			Colloquium. Exam
	Total hours	12	108	3				

*This is a mandatory form of current certification.

INFORMATION AND INSTRUCTIONAL UNIT

LITERATURE

Basic (relevant):

1. Medical chemistry : textbook I / V. O. Kalibabchuk, V. I. Halynska, L. I. Hryshchenko [et al.]; edited by V. O. Kalibabchuk. – Kyiv : «Medicina», 2020. – 224 p.

Additional:

2. Chemical thermodynamics and kinetics for pharmacists / V. V. Khrustalev, V. V. Kantsiava, S. R. Kazulevich – Minsk : BSMU, 2018 – 115 p.
3. Physical and colloid chemistry of real and colloid solutions / V. V. Khrustalev, V. V. Kantsiava, S. R. Kazulevich – Minsk : BSMU, 2018 – 138 p.
4. Colloquium in medical chemistry / V. V. Khrustalev et al. – Minsk : BSMU, 2023. –50 p.
5. Essential chemistry for foreign students / S. V. Tkachev, T. V. Latushko, S. R. Kazulevich, E. V. Barkovsky – Minsk : BSMU, 2019. – 168 p.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

The time allocated for independent work can be used by students for:
 preparation for lectures and laboratory studies;
 preparation for the colloquium, credit, exam;
 solving problems;
 note-taking of educational literature.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF SUPERVISED STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

APPROXIMATE LIST OF TASKS FOR SUPERVISED STUDENT INDEPENDENT WORK:
 studying topics and problems that have not been discussed at the lectures;
 computer testing;

FORMS OF CONTROL OF SUPERVISED STUDENT INDEPENDENT WORK:
 control work;
 preparation of didactic materials;
 tests.

LIST OF AVAILABLE DIAGNOSTIC TOOLS

The following forms of current certification are used to diagnose competencies:
 express-quiz during laboratory work;
 colloquium;
 control work;
 case-based assessment.

LIST OF AVAILABLE TEACHING METHODS

Traditional method;

active (interactive) methods:

Problem-Based Learning (PBL);

Team-Based Learning (TBL);

Research-Based Learning (RBL).

LIST OF PRACTICAL SKILLS

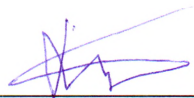
Name of practical skills	Form of practical skills control
1. Determination of the heat effect of the dissolving of a salt, the heat of neutralization	Laboratory work report
2. Determination of the equilibrium constant of a homogeneous reaction	Laboratory work report
3. Construction of a state diagram for a two-component system	Laboratory work report
4. Production of buffer solutions with certain pH	Laboratory work report
5. Conductometric titration of strong and weak acids and their mixture	Laboratory work report
6. Determination of the buffer capacity of the prepared buffer solution	Laboratory work report
7. Measurement of pH of a solution by the potentiometric method	Laboratory work report
8. Potentiometric titration of strong and weak acids	Laboratory work report
9. Production and estimation of coagulation thresholds for sols	Laboratory work report
10. Calculation of the potential of an oxidation-reduction electrode	Laboratory work report
11. Production of emulsions and determination of their types	Laboratory work report
12. Determination of the rate constant for a chemical reaction	Laboratory work report

PROTOCOL OF THE CURRICULUM APPROVAL BY OTHER DEPARTMENTS

Title of the discipline requiring approval	Department	Amendments to the curriculum in the academic discipline	Decision of the department, which designed the curriculum (date, protocol #)
Industrial Technology of Medicines	Department of Pharmaceutical Technology with a course for advanced training and retraining	No proposals	Protocol # 6 of 22.05.2024

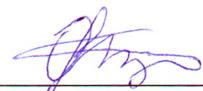
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O.V.Kantsiava

Curriculum content, composition and the accompanying documents comply with the established requirements.

Head of the Office of Educational Activities of the Educational Institution «Belarusian State Medical University»

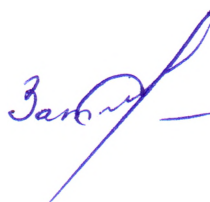
24.06.2024



I.L.Kotovich

Methodologist of the Educational and Methodological Department of the Office of Educational Activities of the Educational Institution «Belarusian State Medical University»

24.06.2024



S.V.Zaturanova