

Ministry of Science and Higher Education of the Russian Federation
Federal State Autonomous Institution of Higher Education
“National Research Nuclear University “MEPhI”

INSTITUTE OF GENERAL PROFESSIONAL TRAINING

DEPARTMENT OF CHEMISTRY

APPROVED ИТС ИФИБ

Protocol No. 3.1

dated 30.08.2024

ACADEMIC COURSE OUTLINE

"CHEMISTRY"

Educational program track (speciality) [1] 31.05.01 General Medicine

Semester	Labour input, credits	Total course academic, hours	Lectures, hrs.	Practical sessions, hrs.	Laboratory sessions, hrs.	In the form of practical studies, hrs.	Independent studies, hrs.	Independent studies monitoring, hrs.	Course progress, Exam/Pass-fail exam/Term
1	2	72	32	0	32		8	0	PFE
2	4	144	30	0	30		30	0	Ex
Total	6	216	62	0	62	0	38	0	

ABSTRACT

The aims of the study of the discipline "Chemistry" are deepened of existing ideas and generate new knowledge and skills in the field of chemistry. This knowledge is essential for understanding and finding solutions to modern technological, environmental and raw material problems of the nuclear industry. Feature of the program is the fundamental nature of its presentation. It is necessary for the formation of common cultural and bachelors of general competencies, attitudes and development of chemical thinking. The course examines the electron theory of atomic structure, the theory of chemical bond, elements of chemical thermodynamics, chemical elements and their basic compounds, including elements of nuclear energy, methods of segregation, purification and identification of substances.

The theoretical part of the discipline is presented in the lecture course. Acquired knowledge is fixed on laboratory studies, which are formed on the skills of responsible attitude to the substance. Self-study includes work with textbooks, manuals and reference materials, preparation for practical classes, homework, preparing for tests and writing essays.

1. ACADEMIC COURSE GOALS AND OBJECTIVES

The aims of the study of the discipline "Chemistry" are deepened of existing ideas and generate new knowledge and skills in the field of chemistry. This knowledge is essential for understanding and finding solutions of modern technological, environmental and raw material problems of the nuclear industry. Feature of the program is the fundamental nature of its presentation. It is necessary for the formation of common cultural and bachelors of general competencies, attitudes and development of chemical thinking

2. PLACE OF THE ACADEMIC COURSE IN THE MAIN HIGHER EDUCATION CURRICULUM

The training course is included into a cycle of mathematical and natural-scientific disciplines. Basic knowledge of chemistry, physics and mathematics at the level of a secondary school is necessary for studying of the discipline.

3. DEVELOPED COMPETENCIES AND INTENDED LEARNING OUTCOMES

Universal and/or general professional competencies:

Competency code and title	Code and title of competency-based rubrics
OIIK-5 [1] – Capable of assessing morphofunctional and physiological states, as well as pathological processes in the human body to solve professional tasks.	3-OIIK-5 [1] – Know: - basic medical, pharmaceutical, and morphofunctional terminology, including Latin terms; - structure and functions of the human body, age-related, gender-specific, and individual characteristics of the structure and development of a healthy organism; - physical and chemical nature of processes occurring in a living organism; - patterns of vital activity of the organism, mechanisms of self-regulation and regulation; - features of regulation of the functioning of human body systems in pathological conditions; - patterns of occurrence, development, and outcome of typical pathological processes, the concept of sanogenesis; - etiology and

	<p>pathogenesis of the most common diseases; - the concept of nosology, principles of disease classification; - principles of microorganism classification, their morphology, physiology, and impact on human health; - structure and functions of the human immune system.</p> <p>Y-OPIK-5 [1] – Be able to: - analyze mechanisms of disease development and manifestation; - recognize morphological and functional changes in cells, tissues, organs, and systems of the human body; - use basic physical-chemical and other natural science concepts and methods in solving professional tasks; - determine the cause of death and formulate a pathological diagnosis.</p> <p>B-OPIK-5 [1] – Possess skills in: - conducting microscopy and analyzing microscopic specimens; - correlating morphological and clinical manifestations of diseases; - assessing morphofunctional, physiological states, and pathological processes in humans; - clinical-anatomical analysis of autopsy results.</p>
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4. PEDAGOGIC POTENTIAL OF THE COURSE

Pedagogic tracks/objectives	Pedagogic goals (code)
Environmental education	Establishing conditions for: fostering a respectful and caring attitude towards nature and the environment (B9)
Intellectual education	Establishing conditions for: formation of culture of intellectual work (B11)
Vocational and labor education	Establishing conditions for: formation of a deep understanding of the profession's social role, a positive and active commitment to the values of the chosen specialty, and a responsible attitude towards professional activity and work (B14)

5. ACADEMIC COURSE STRUCTURE AND CONTENT

Academic course sections, their scope, terms of study and assessment:

No.	Academic course section name	Weeks	Lectures/ Practical (seminars)/ Laboratory sessions, hrs.	Compulsory current assessment (form*, week)	Maximum grade per section**	Section assessment (form*, week)	Competency-based rubrics
	<i>1 Semester</i>						
1	Chemical systems. Atomic structure and	1-7	12/0/12	Lab-1 (5),T-1	20	TstP-8	3-OPIK-5

	chemical bonding.			(5),Lab-3 (5),T-3 (5),HA-4 (5),T-5 (5),T-5 (5)			
2	Basic laws of chemical processes	7-12	12/0/12	T-9 (5),Lab-9 (5),HA-10 (10),Lab-11 (5),T-11 (5)	15	TstP-12	Y-ОПК-5
3	Acid-base systems. Equilibrium in aqueous solutions	12-16	8/0/8	Lab-13 (5),T-13 (5),Cq-15 (10)	15	TstP-16	3-ОПК-5, Y-ОПК-5, B-ОПК-5
	<i>Totals for 1 Semester</i>		32/0/32		50		
	Assessment events for 1 Semester				50	PFE	3-ОПК-5, Y-ОПК-5, B-ОПК-5
	<i>2 Semester</i>						
1	Dispersed systems, solutions	1-4	8/0/8	Lab-1 (5),T-1 (5),T-3 (5),Lab-3 (5)	15	TstP-4	3-ОПК-5
2	Electrochemical systems	5-7	8/0/8	TstP-5 (10),T-7 (5),Lab-7 (5)	15	TstP-8	3-ОПК-5, Y-ОПК-5
3	Properties of s-, d-, and f-elements. Radioactivity and radiochemistry	8-15	14/0/14	Lab-9 (5),T-9 (5),T-11 (5),Lab-11 (5)	20	LHA-15	3-ОПК-5, Y-ОПК-5, B-ОПК-5
	<i>Totals for 2 Semester</i>		30/0/30		50		
	Assessment events for 2 Semester				50	Ex	3-ОПК-5, Y-ОПК-5, B-ОПК-5

* – abbreviated name of assessment

** – 100 maximum points per semester including a pass/fail exam and (or) an exam

Abbreviated current assessment forms and section assessment

Abbreviation	Full name
Cq	Colloquium
HA	Home assignment
Lab	Laboratory-based work
LHA	Large home assignment
T	Testing

TstP	Test paper
PFE	Pass/fail examination
Ex	Exam

SYLLABUS

Weeks	Topics / Content	Lect., hrs.	Pr./sem., hrs.	Lab., hrs.
	<i>1 Semester</i>	32	0	32
1-7	Chemical systems. Atomic structure and chemical bonding.	12	0	12
1	Chemical systems. Structure of atom and chemical bonding Subject and methods of chemistry. The place of chemistry in system of fundamental sciences. Basic main types of chemical compounds and their symbolical image. Chemical system. Substance, his phase states and chemical transformations. Main properties of chemical systems. Chemical duality. Types of chemical transformations. Oxidation-reduction reactions (ORR). Typical oxidizers and reducers. Methods of drawing up equations of ORR.	All 2	0	2
		Online		
		0	0	0
2 - 3	Chemical systems. Structure of atom and chemical bonding. Electron structure of atom and Periodic law Atom and its characteristics: nucleus, electron shell, nucleus charge, mass of a nucleus, sizes of a nucleus and atom. Isotopes. Quantum-mechanical model of atom: quantum numbers, types of orbital's. Order of filling of levels and subtotals (energy minimum, Paulie's principle, Hund's rule). Electronic formulas of elements. Formulas in the form of energetic cells. Element valence for the basic and the excited states of the atom. Periodic system (PSE) of D. I. Mendeleyev. Interrelation of chemical properties of simple substances with an electronic structure of atoms. Cases of discrepancy of the highest valence of an element to number of PSE group. Dependences of radii of atoms, energy of ionization, affinity to an electron and electronegativity from the location of an element in PSE. Metals and nonmetals.	All 4	0	4
		Online		
		0	0	0
4 - 6	Chemical systems. Structure of atom and chemical bonding. Chemical bonding. Main types (covalent, ionic, donor-acceptor, hydrogen and metallic) and characteristics (energy, length, orientation, polarity and polarizability) of a chemical bond. Interrelation of a look and properties of a chemical bond and electronegativity. Properties of a chemical bond and structure of molecules. Oxidation degree. Intermolecular interactions. Structural formulae of molecules and associates.	All 6	0	6
		Online		
		0	0	0
7-12	Basic laws of chemical processes	12	0	12
7	Chemical thermodynamic.	All		

	Chemical thermodynamic. Functions of a state. Thermal effect and enthalpy of reaction. Laws of thermochemistry. Enthalpy of formation of chemical compounds. Standard state. Entropy. Gibbs's energy, its communication with the direction of chemical processes. Calculation of thermodynamic functions of chemical reactions for handbook data. Assessment of reactionary ability and stability of substances.	2	0	2
		Online		
		0	0	0
8 - 9	Chemical equilibrium Reversible and irreversible reactions. Chemical potential and its properties. Activity and coefficient of activity. Law of action of masses. Thermodynamic and concentration constants of equilibrium. Calculation of chemical equilibria: equilibrium concentration, extent of transformation. Le Chatelie's principle. Chemical equilibrium in solutions. Dissociation of weak electrolytes. Hydrolysis. Shift of balance of water dissociation in solutions of electrolytes. Hydrolysis on a cation and an anion: change of character of the environment. Constant and degree of hydrolysis. Chemical equilibrium in heterogeneous systems. Bertlo-Nernst's law. Solubility product.	All		
		4	0	4
		Online		
		0	0	0
10 - 12	Chemical kinetics Speed of homogeneous chemical reactions. Kinetic equations, constant of reactions speed, simple and complex reactions, order and molecularity. Kinetic equation of reactions of the first order. Dependence of speed of reaction on temperature. Vant Hoff's rule. Arrhenius's equation. Energy of activation. Chain and oscillatory reactions. Physical methods of activation and acceleration of reactions. Catalysis, catalysts, enzymes.	All		
		6	0	6
		Online		
		0	0	0
12-16	Acid-base systems. Equilibrium in aqueous solutions	8	0	8
13	Coordination compounds Coordination compounds and double salts. Typical central atoms and ligands. Interrelation of a structure of complexes with hybridization of orbitals and electronic structure of a central atoms. Coordination number. Ligands properties. Properties of complex compounds, equilibrium constant. Destruction of complexes in the competing reactions. Classification of complex compounds. Helates. Selectivity at a complex formation of ions of metals with macrocyclic ligands. Alkaline metals in unusual oxidation degrees.	All		
		2	0	2
		Online		
		0	0	0
14 - 15	Solutions Ideal and real solutions. Solvation (hydration) of electrolytes; dissociation, ionic and molecular association. Strong and weak electrolytes. Solvents and their properties. Features of water as solvent. Electrolytic dissociation of water and hydrogen indicator. Raul and Vant Hoff's laws. Colligative properties of solutions (osmotic pressure, temperatures of boiling and freezing).	All		
		4	0	4
		Online		
		0	0	0

16	Solutions Properties of real solutions. Activity of electrolytes. Average ionic coefficient of activity. Limit law of Debye-Hukel. Constant and degree of dissociation of weak electrolytes. Ostwald Law of dilution.	All		
		2	0	2
		Online		
		0	0	0
	<i>2 Semester</i>	30	0	30
1-4	Dispersed systems, solutions	8	0	8
1 - 2	Colloid systems Dispersion and disperse systems. Classification of colloidal systems. Liquid colloid solutions and gels. Micelle structure. Peskov-Fayan's rule. Adsorption. Surface-active substances and their influence on properties of disperse systems and superficial tension. Properties of colloidal systems (aggregate and kinetic stability, sedimentation, coagulation, peptization, optical and electric properties). Methods of receiving and destruction of colloidal systems. Nanotechnologies and other scopes..	All		
		4	0	4
		Online		
		0	0	0
3 - 4	Acid and base systems Proton and electronic theories of acids and bases. Lewis's and Bronsted's acids. The interfaced acids and the bases.	All		
		4	0	4
		Online		
		0	0	0
5-7	Electrochemical systems	8	0	8
5 - 8	Electrochemical systems Electrochemical systems Types of electrochemical processes. Oxidation-reduction systems. Double electric layer, electrode potential, Nernst's equation. Galvanic cell. The electromotive force. Electrolysis. Main types of corrosion of metals. Methods of protection against corrosion.	All		
		8	0	8
		Online		
		0	0	0
8-15	Properties of s-, d-, and f-elements. Radioactivity and radiochemistry	14	0	14
9	Hydrogen Hydrogen. Chemical properties: interaction with simple substances. Atomic hydrogen. Hydrides (ionic, covalent, introduction connections), methods of receiving and property. Isotopes of hydrogen and methods of their division. Isomers. Hydrides as energy carriers. Hydrogen energetic.	All		
		2	0	2
		Online		
		0	0	0
10	f-elements f-elements. General and comparative characteristic. Lanthanoid and actinoid compression, regularities of change of oxidation degrees. Chemical properties in various oxidation levels. Complex compounds. Methods of separation and receiving. Scopes. Chemistry of cerium, europium, thorium, uranium. Actinoids in nuclear power industry.	All		
		2	0	2
		Online		
		0	0	0
11	Radioactivity and radiochemistry	All		

	Radioactivity and radiochemistry. Radioactivity and its types. Stability zone. Interaction of radiation with substance. Nuclear reactions. Synthesis of new elements. Sources of radiation and their impact on an organism.	2	0	2
		Online		
		0	0	0
12	s- and d- metals of 1st and 2nd groups. p- and d- elements of 4th group s- and d- metals of 1st and 2nd groups Comparison of an electronic structure and reactionary ability. Lithium, beryllium. Compounds of copper and gold in various oxidation degrees. Methods of receiving and scope. p- and d- elements of 4th group Comparison of properties. Nonmetals and semiconductors of 4th group (silicon and germanium). Titan, zirconium, hafnium. Methods of receiving and scope.	All		
		2	0	2
		Online		
		0	0	0
13	Separating systems Distribution of substances between phases: liquid-steam (distillation, rectification), liquid-liquid (extraction), liquid-solid (deposition, cementation, dissolution, an ionic exchange). Gas transmission reactions. Sorption.	All		
		2	0	2
		Online		
		0	0	0
14	Chemical identification and measurement Purity of substance. Analytical signal. Qualitative and quantitative analysis. Qualitative reactions. Standard sample. Test and its presentability. Error of chemical measurement. Use of regularities of phase distribution in chemical measurements.	All		
		2	0	2
		Online		
		0	0	0
15	Chemical and biological systems. Maximum allowable concentration and methods of their definition. Toxicity. Ranks of toxicity of heavy metals. Methods of minimization of impact of toxic elements on health.	All		
		2	0	2
		Online		
		0	0	0

Abbreviated names of online options:

Abbreviation	Full name
EC	E-course
FtM	Full-text material
FtL	Full-text lectures
VM	Video materials
AM	Audio materials
Prs	Presentations
T	Tests
ERM	E-reference materials
IS	Interactive site

LABORATORY (LAB) SESSIONS TOPICS

Weeks	Topics / Content
	<i>1 Semester</i>

1 - 2	Chemical systems. Structure of atom and chemical bonding Classes of inorganic substances. the foundations of a rational nomenclature. Laboratory work. Foundations of rational nomenclature
3 - 4	Chemical systems. Structure of atom and chemical bonding Laboratory work . "The types of chemical transformations". Exchange reaction, substitution, connection, decomposition, redox reactions
5 - 6	Chemical systems. Structure of atom and chemical bonding. Chemical bonding Main types of chemical bonds. Test. "The structure of atom and chemical bond"
7 - 8	Chemical systems. Structure of atome and chemical bonding Laboratory work "Quantative analysis"
9 - 10	Energetics of chemical processes The results of homework "Energetics of chemical processes".
11 - 12	Chemical kinetics Laboratory work "Chemical kinetics"
13 - 14	Chemical equilibrium Laboratory work. Chemical equilibrium
15 - 16	Complex compounds Laboratory work. Complex compounds
	<i>2 Semester</i>
1 - 2	Disperce systems, solutions Laboratory work "Disperce systems"
3 - 4	Solutions Laboratory work. Solutions
5 - 6	Electrochemical systems Laboratory work "Redox reactions"
7 - 8	Electrochemical systems Electrolysis
9 - 10	Properties of elements Laboratory work "Properties of f-elements"
11 - 12	PChemical identification Laboratory work "Qualitative reactions.
13 - 14	Separating systems Laboratory work "Separating systems"
15 - 16	Typical tasks for the chemistry course Protection homework

6. EDUCATIONAL TECHNOLOGIES

teaching and research work in the framework SHIB-19 (student chemical research Bureau)

- Preparation of abstracts and electronic presentations of lectures
- Cathedral conference of research studies with the involvement of representatives of other universities of Moscow.
- students work with electronic textbooks, home computer training on topics (system MEFIST)

7. ASSESSMENT TOOLKIT

The assessment toolkit ensures verification of the intended learning outcomes achievement (competency-based rubrics) using current, midterm and interim assessment of the course.

The link between developed competencies and their assessment is presented in the following table:

Competency	Achievement rubrics	Assessment activity (Syl 1)	Assessment activity (Syl 2)
ОПК-5	3-ОПК-5	PFE, TstP-8, TstP-16, JIP-1, T-1, JIP-3, T-3, T-5, ДЗ-4, T-9, JIP-9, JIP-11, T-11, ДЗ-10, JIP-13, T-13, КЛ-15	Ex, TstP-4, TstP-8, LHA-15, JIP-1, T-1, T-3, JIP-3, T-7, JIP-7, к.р-5, JIP-9, T-9, T-11, JIP-11
	У-ОПК-5	PFE, TstP-12, TstP-16, T-9, JIP-9, JIP-11, T-11, ДЗ-10, JIP-13, T-13, КЛ-15	Ex, TstP-8, LHA-15, T-7, JIP-7, к.р-5, JIP-9, T-9, T-11, JIP-11
	В-ОПК-5	PFE, TstP-16, JIP-13, T-13, КЛ-15	Ex, LHA-15, JIP-9, T-9, T-11, JIP-11

Educational achievement rubrics scales

The scale of each assessment activity varies from 0 to the maximum established point, inclusive. The final assessment of the course is performed on a 100-point scale and represents the sum of the points earned by the student in the section assessments, framework of current and interim assessment.

Sections and interim assessments are considered passed when the student achieves a minimum score equal to 60% of the maximum. The final grade is assigned only upon passing all sections and the interim assessment.

The final grade is assigned in accordance with the following scale:

Total score	Rating on a 4-point scale	Pass/fail examination	ECTS assessment
90-100	5 – « <i>excellent</i> »	« <i>pass</i> »	A
85-89	4 – « <i>good</i> »		B
75-84			C
70-74			D
65-69	3 – « <i>satisfactory</i> »		E
60-64		F	
below 60	2 – « <i>fail</i> »	« <i>fail</i> »	

An “excellent” grade indicates a deep and solid mastery of the program material by a student who presents their answers consistently, clearly, and logically, is able to closely link theory with practice, and uses materials from monographic literature in their answers.

A “good” grade corresponds to a student’s solid knowledge of the material, who presents their answers competently and to the point, without any significant inaccuracies.

A “satisfactory” grade corresponds to the basic level of mastery of the material by the student, in which the main material has been mastered, but its details have not been assimilated, the answers contain inaccuracies, insufficiently correct wording and logical inconsistencies.

A grade “pass” corresponds to at least a basic level of mastery of the program material, in which the student possesses the necessary knowledge, skills, and abilities, and is able to apply theoretical principles to solve typical practical problems.

A grade “fail” is given to a student who lacks a significant understanding of the curriculum material, makes significant errors in their answers, or fails all required assignments. These students are generally unable to continue their studies without additional classes.

8. ACADEMIC COURSE EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT

CORE READING:

1. 544 З-19 Закономерности протекания химических реакций (химическая термодинамика, кинетика, равновесие) : учебное пособие по курсу общей химии, Кучук Ж.С. [и др.], Москва: НИЯУ МИФИ, 2015
2. ЭИ З-19 Закономерности протекания химических реакций (химическая термодинамика, кинетика, равновесие) : учебное пособие по курсу общей химии, Кучук Ж.С. [и др.], Москва: НИЯУ МИФИ, 2015
3. ЭИ Н52 Неорганическая химия : учебное пособие для вузов, Кучук Ж.С. [и др.], Москва: МИФИ, 2007
4. 546 Н52 Неорганическая химия : учебное пособие для вузов, Кучук Ж.С. [и др.], Москва: МИФИ, 2007
5. 54 А95 Общая и неорганическая химия : учебник для вузов, Ахметов Н.С., Москва: Высшая школа, 2009
6. 54 О-28 Общая химия : лабораторный практикум: учебное пособие для вузов, Месяц Е.А. [и др.], Москва: НИЯУ МИФИ, 2010
7. ЭИ О-28 Общая химия : лабораторный практикум: учебное пособие для вузов, Месяц Е.А. [и др.], Москва: НИЯУ МИФИ, 2010
8. 54 К68 Общая химия : учебник, Коровин Н.В., Москва: Академия, 2013
9. 54 С23 Сборник тестов и задач по курсу химии : , Орлова А.А. [и др.], Москва: НИЯУ МИФИ, 2014
10. ЭИ С23 Сборник тестов и задач по курсу химии : учебное пособие, Орлова А.А. [и др.], Москва: НИЯУ МИФИ, 2014
11. 544 Э45 Электрохимия : учеб. пособие для вузов, Глаголева М.А. [и др.], Москва: МИФИ, 2006

FURTHER READING:

1. 54 E14 General Chemistry : учеб. пособие, Steven D., Ebbing D.D., : Brooks/Cole Cengage Learning, 2013
2. 54 X76 Пособие по химии для поступающих в вузы : , Хомченко Г.П., Москва: Новая Волна, 2007
3. 546 T18 Уран : учебное пособие для вузов, Тананаев И.Г., Москва: НИЯУ МИФИ, 2011
4. 544 А64 Химическая термодинамика, равновесие и кинетика : учеб. пособие для вузов, Сергиевский В.В., Ананьева Е.А., Звончевская М.Ф., Москва: МИФИ, 2004
5. 546 X46 Химия переходных металлов : учебное пособие, Вагина Н.С. [и др.], Москва: МИФИ, 1989
6. 544 X46 Химия растворов : учеб. пособие для вузов, Сергиевский В.В. [и др.], Москва: МИФИ, 2005
7. 544 Э45 Электрохимия : учеб. пособие для вузов, Глаголева М.А. [и др.], Москва: МИФИ, 2006

SOFTWARE:

No special softwares is required

LMS AND ONLINE RESOURCES

1. дистанционное обучение НИЯУ МИФИ (<http://lms.mephi.ru/index.php>)
2. электрохимические процессы (<https://online.mephi.ru/course/view.php?id=224>)
3. свойства элементов и их соединений (<https://online.mephi.ru/course/view.php?id=224>)
4. Химическая идентификация и методы разделения и очистки (<https://online.mephi.ru/course/view.php?id=224>)
5. электрохимические процессы (<https://online.mephi.ru/course/view.php?id=224>)
6. общая химия (<https://online.mephi.ru/course/view.php?id=224>)

<https://online.mephi.ru/>

<http://library.mephi.ru/>

9. LOGISTICAL SUPPORT

1. Кафедра оснащена необходимым оборудованием, химической посудой и реактивами для реализации лаборатор ()
2. Кафедра оснащена необходимым оборудованием, химической посудой и реактивами для реализации лаборатор (Б-202, Б-204, Б-201)

10. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR STUDENTS

Methodological guidelines for students in this discipline.

During the first lesson in this discipline, students receive detailed information on the class schedule, the structure of each lesson, and the grading system.

For each lesson, students complete homework (an individual version from a collection of tests and problems for the chemistry course) in preparation for the entrance examination on the topic and take a test on the topic being studied on the online.mephi.ru portal. Homework includes a written lab assignment.

Students are not admitted to the lesson without homework.

At the beginning of the lesson, before each lab assignment, students complete entrance examination tests to gain admission to the lab. The purpose of these tests is to assess the student's understanding of the theoretical portion of the lab and their readiness to perform the experiment. The entrance examination tests last 15-20 minutes.

In addition to the entrance examination tests, admission to the laboratory work includes an oral interview discussing the purpose of the work, safety precautions for working with equipment and reagents, the experimental methodology, and the sequence of stages of the laboratory work.

Upon completion of the experiment, the student defends the laboratory work. They present the results to the instructor, where they must explain them, draw conclusions, and answer the questions of the laboratory defense examination tests.

At the end of the lesson, the student receives a final grade, which includes the entrance examination test results and the grade for completing and defending the laboratory work.

To prepare for the lesson, students are recommended to use the following:

lecture course;

textbooks and teaching aids listed in the recommended reading list;

electronic textbooks on online.mephi.ru

electronic courses on the open education portal

Final assessment for the course is conducted in the format prescribed by the curriculum.

Student Knowledge Quality Assurance System

• Ongoing assessment – a form of quality control for the student's learning of individual elements of the course and the completion of assignments during both classroom and independent work. The form and timing of ongoing assessments, as well as their contribution to the final grade, are specified in pre-approved course syllabi.

• Section assessment is a form of assessment of the student's knowledge quality, conducted upon completion of a section of the academic discipline. The form and timing of assessment, as well as its contribution to the final grade, are specified in pre-approved course syllabi.

• Midterm assessment (hereinafter, assessment) is the assessment of students in the disciplines studied during the semester. The forms of assessment for each discipline are determined by the curriculum.

• Final assessment is a form of assessment of the student's knowledge quality, conducted upon completion of the course. The form and timing of final assessments are specified in the working curricula. Student Knowledge Assessment System

Requirements for Student Knowledge, Skills, and Competencies

• The maximum score for this type of assessment (equivalent to an "excellent" grade on a 5-point scale) is awarded to a student who has thoroughly mastered the chemistry topic being studied,

presents it comprehensively, consistently, clearly, and logically, is able to closely link theory with practice, and utilizes modern scientific chemistry material in their answer.

- A score equivalent to 70–89% of the maximum (equivalent to a "good" grade on a 5-point scale) is awarded to a student who has a solid understanding of the material, presents it competently and to the point, and avoids significant inaccuracies in answering questions and completing assignments.
- A score equivalent to 60–69% of the maximum (equivalent to a "satisfactory" grade) is awarded to a student who has only mastered the core material but has not grasped its details, makes inaccuracies, uses inaccurate wording, or lacks logical consistency in the presentation of the program material.

- A score equivalent to less than 60% of the maximum (equivalent to an "unsatisfactory" grade) is awarded to a student who lacks mastery of a significant portion of the program material and makes significant errors. As a rule, a "unsatisfactory" grade is awarded to students who cannot continue their studies without additional classes in the relevant course.

The final grade is the sum of the points earned by the student during the semester through ongoing assessment, section assessment, and the test or exam. Educational Achievement Assessment Scale

Assessment on a 5-point scale Total points for sections ECTS assessment

5 – “excellent” 90-100 A

4 – “good” 85-89 B

75-84 C

70-74 D

3 – “satisfactory” 65-69

60-64 E

2 – “unsatisfactory” Below 60 F

11. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR TEACHERS

Methodological guidelines for instructors in this discipline.

During the first lesson in this discipline, students must be familiarized with the lesson schedule, the structure of each lesson, and the grading system.

At the beginning of each lesson, the instructor should provide an explanation of the topic being covered, provide students with the opportunity to ask additional and clarifying questions, and conduct a written assessment on the topic. Evaluate the students' responses.

Before beginning the lab, the instructor should check the written documentation in the lab journal and the students' theoretical preparation for the lab.

During the lab, the instructor should assess the student's mastery of experimental techniques, skills in working with chemicals, measuring glassware, and laboratory analytical equipment.

The final part summarizes the lesson, assessing the student's mastery of the topic being covered, as well as their ability to draw conclusions from the experimental results and justify them based on their theoretical knowledge. Ongoing assessment is carried out in accordance with the assessment schedule. It develops students' communicative competence, the ability to give oral explanations and answers, and encourages systematic work and self-analysis. Ongoing assessment

allows students to prepare for the final assessment in a discipline without the stress of pre-exam preparation.

Midterm assessments are conducted in accordance with the curriculum in written form, with mandatory oral explanations.

Final assessments in a discipline are conducted in the form specified by the curriculum.

Student Knowledge Quality Assurance System

•Ongoing assessment is a form of assessment of the quality of student learning of individual elements of a discipline and the completion of assignments as part of the student's classroom and independent work. The form and timing of ongoing assessment, as well as its contribution to the final grade, are specified in pre-approved course syllabi.

•Section assessment is a form of assessment of the quality of student knowledge, conducted at the end of a section of an academic discipline. The form and timing of assessment, as well as its contribution to the final grade, are specified in pre-approved course syllabi. • Midterm assessment (hereinafter referred to as assessment) – student assessment of the subjects studied during the semester. The assessment formats for each subject are determined by the curriculum.

• Final assessment – a form of quality control of a student's knowledge, conducted upon completion of a subject. The format and timing of the final assessment are specified in the working curricula.

Student Knowledge Assessment System

Student Knowledge, Skills, and Proficiency Requirements

The maximum score for this type of assessment (equivalent to an "excellent" grade on a 5-point scale) is awarded to a student who has thoroughly mastered the chemistry topic, presents it comprehensively, consistently, clearly, and logically, is able to closely link theory with practice, and utilizes modern scientific material in chemistry in their answer. A score between 70% and 89% of the maximum (equivalent to a "good" grade on a 5-point scale) is awarded to a student who has a solid knowledge of the material, presents it clearly and to the point, and avoids significant inaccuracies in answering questions and completing assignments.

A score between 60% and 69% of the maximum (equivalent to a "satisfactory" grade) is awarded to a student who has only mastered the basic material but has not grasped its details, makes inaccuracies, insufficiently correct wording, and lacks logical consistency in presenting the program material.

A score below 60% of the maximum (equivalent to an "unsatisfactory" grade) is awarded to a student who lacks a significant knowledge of the program material and makes significant errors. As a rule, an "unsatisfactory" grade is awarded to students who cannot continue their studies without additional classes in the relevant subject. Academic Achievement Assessment Scale

Assessment on a 5-point scale Total points for sections ECTS score

5 – “excellent” 90-100 A

4 – “good” 85-89 B

75-84 C

70-74 D

3 – “satisfactory”

65-69

60-64 E

2 – “unsatisfactory” Below 60 F

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