Name of subject	Chemistry (ECTS 4)
Subject/module code	KIM1104
Science taught semester (s).	1st semester
Responsible teacher	Khakberdiev Shukhrat Makhramovich (PhD), associate professor.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-120.** **Audience Training hours – 48** Lecture training hour –24 Laboratory training hour – 12 Practical training hour – 12 **Independent education -72 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject** The goal is to develop the student's ability to think chemically, apply chemical laws in modern technology, familiarize themselves with and study the properties of materials and substances used in technology, and develop the skills to apply them in practice. **The task of the subject** to reveal the role and importance of a specialist in his work by forming theoretical knowledge, practical skills, a methodological approach and a scientific worldview necessary for logical observation of the content of chemical phenomena and processes. The purpose of "Green Chemistry" is to develop practical skills in students on the 12th principle of "Green Chemistry", which is to select synthesis methods in the following chemical processes, to achieve that reagents and substances obtained are less harmful to humans and the environment when choosing synthesis methods, to reduce toxicity while maintaining their effectiveness when creating new chemicals, to avoid the use of toxic additional solvents and separating reagents in production, to always try to choose the most selective catalytic processes, and to minimize chemical hazards such as explosions, combustion and leakage of substances used in chemical processes. **Learning outcomes:** As a result of mastering the subject, the student should: • have the skills to connect the theoretical knowledge being studied with practice; • have the ability to know the relationship of the phenomena being studied and to objectively describe them; • know the laws and properties of chemistry and be able to use them; • understand the program materials and have an imagination in the process of preparing for classes on chemical compounds
Course content (topics)	**I. Module 1. Introduction. Basic concepts and laws of chemistry** **Topic 1.** Basic concepts of chemistry. Basic laws of chemistry Introduction. Chemical science and industry in Uzbekistan. Purpose, tasks of chemistry. Basic concepts of chemistry: atom, molecule, gram-atom, gram-molecule, chemical compound, chemical element, chemical formula, chemical reaction, chemical equation. Simple and complex substances. Classes of inorganic compounds. Basic laws of chemistry. Stoichiometric laws: Law of conservation of mass of matter. Law of constancy of composition of matter. Law of equivalents. Law of multiple proportions. Avogadro's law. **Topic 2.** Atomic structure. D.I. Mendeleev's periodic table of elements. Types of chemical bonds Atom is a complex system. Atomic structure. Atomic nuclei. Electron

clouds of an atom. Bohr's postulates. The order and regularity of filling atomic orbitals with electrons. Electronic configuration. Normal and excited states of atoms.

D.I. Mendeleev's periodic table of elements. Dialectical description of the periodic law. Change in the properties of chemical elements. The general significance of the periodic system and the law.

The concept of chemical bonding. The main types of chemical bonding and their interrelationships. Ionization energy. Electron affinity. Electromagnetic affinity of elements. Covalent bonding. Types of covalent bonding. Bond polarity. Ionic bonding. Hydrogen bonding. Coordination bonding. Mechanism of formation of donor-acceptor bonds in complex compounds. Types of crystal lattices. Metallic bonding.

Topic 3. Chemical kinetics and chemical equilibrium. Information about chemical kinetics. Chemical reaction rate and factors affecting it. Homogeneous and heterogeneous reactions. Effect of concentration on reaction rate. Law of mass effect. Rate constant. Van't-Hoff's rule. Catalysts. Catalysis. Homogeneous and heterogeneous catalysis.

Reversible and irreversible reactions. Chemical equilibrium and factors affecting it. Shift of equilibrium. Le Chatel's principle. Equilibrium constant. Importance of chemical kinetics and equilibrium in industry.

Topic 4. Water. Properties and hardness of water. Water in nature. Structure of the water molecule. Phase diagram of water. Physical and chemical properties of water. Water hardness and methods of its removal. Importance of water in human health, national economy and technology.

Topic 5. Solutions. Disperse systems and their description. Classification of disperse systems. Coarsely dispersed systems. Colloidal solutions. Pure solutions. Diluted, concentrated solutions. Saturated, unsaturated and supersaturated solutions. Concentration of solutions. Solutions with percent, molar, normal and molal concentrations. Titer of the solution. Solubility. Use of solutions and their role in technology.

Topic 6. Theory of electrolytic dissociation. Ionic equations. Hydrolysis of salts

Electrolyte and non-electrolyte solutions. Aqueous solutions of electrolytes. Electrolytic dissociation. S. Arrhenius theory. Acid and base theory. Stepwise dissociation. Degree of dissociation. Strong and weak electrolytes. Dissociation constant. The importance of the theory of electrolytic dissociation in technology.

Properties of electrolyte solutions, ionic activity. Ionic equations of solutions. Solutions of acids, bases, and salts and ion exchange reactions between them. Ionic density of water. Solution environment. Indicators. Hydrogen indicator. Hydrolysis. Types of hydrolysis of salts. Degree and constant of hydrolysis. Industrial applications of hydrolysis.

Module 2. Electrochemistry

Topic 7. Redox reactions. Oxidation degree and valence. Types of chemical reactions. Theory of redox reactions. Oxidants and reducing agents. Types of redox reactions. Methods for constructing equations of redox reactions: electron balance and ion-electron methods.

Topic 8. Electrochemical processes. Electrochemistry. The concept of electronic potentials of metals. Hydrogen electrode. Voltage series of metals. Nernst-Tyurin equation. Galvanic elements and their mode of operation. Electromotive force. Use of galvanic elements and their role in technology.

Electrolysis. Processes occurring at the anode and cathode. Insoluble and soluble anodes. Laws of electrolysis. The importance of electrolysis in industry. Methods of galvanoplastics and galvanostegy.

Module 3. Chemistry of metals

Topic 9. General properties of metals. Alloys. Distribution and

	occurrence of metals in nature. Production of metals. Physical properties of metals. Chemical properties of metals. Dependence of the properties of metals on their location in the periodic system of elements of D.I. Mendeleev. Light and heavy metals. Use of metals. Alloys. Types and properties of alloys. Phase diagrams. Physicochemical analysis of metal alloys. Intermetallic compounds and solid solutions of metals. Production and importance of alloys in industry. **Topic 10.** Corrosion of metals and methods of protection against it. Main types of corrosion. The harm caused by corrosion to the national economy. Chemical corrosion of metals. Electrochemical corrosion and its types. Combating corrosion of metals. Methods of protecting metals from corrosion. Isolation of metals from aggressive environments, protective layers. Electrochemical protection methods (protective, cathodic and anodic protection). Changing the properties of the corrosive environment, corrosion inhibitors and activators. The economic importance of protecting metals from corrosion. **Module 4. Fundamentals of organic chemistry** **Topic 11.** Classification of organic compounds. Formation of organic compounds and organic chemistry. Theoretical views on the chemical structure of organic compounds. A.M. Butlerov's classification of organic compounds. Hydrocarbons. Saturated and unsaturated hydrocarbons. Alcohols, aldehydes, ketones, carboxylic acids, esters, nitrogenous organic compounds. **Topic 12.** High molecular compounds. High molecular compounds. Polymers and elastomers. Polymerization and polycondensation reactions, their mechanisms. Physicochemical, mechanical properties and uses of polymers and elastomers. Composition of plastics and elastomers. Application of plastics and plastomers in technology. **II. Instructions and recommendations for practical training:** The purpose of practical training is to understand the theory, acquire skills. It is to develop the ability to consciously apply it in educational and professional activities, to confidently form one's own point of view. 1. Classes of inorganic compounds. Basic laws of chemistry. 2. Atomic and molecular structure. 3. Thermochemistry. 4. Chemical kinetics and equilibrium. 5. Hydrolysis of electrolyte solutions and salts. 6. Oxidation-reduction reaction. Corrosion of galvanic elements and metals. **III. Instructions and recommendations for laboratory exercises:** 1. Safety rules in chemical laboratories. Familiarity with chemical containers and equipment. Classes, production and properties of inorganic compounds. Determination of the equivalent of a metal relative to hydrogen. 2. Factors affecting the rate of a chemical reaction. Chemical equilibrium. Shift of equilibrium. 3. Determination of water hardness. Determination of solution concentration. 4. Properties of strong and weak electrolytes. Ionic equations. Hydrolysis of salts. 5. Oxidation-reduction reactions. Electrochemistry. Galvanic cell. Electrolysis process. 6. Chemical properties of metals. Corrosion of metals and methods of preventing it. The student consolidates the theoretical knowledge gained from lecture classes of the subject in educational laboratory exercises. The student performs laboratory work under the supervision of a laboratory assistant and completes a report and submits it to the subject teacher.

	IV. Independent learning and independent work The competence of independent learning serves to assist students in independent self-development and increase the effectiveness of professional activity. Students perform independent work on their mobile devices under the guidance of a teacher in a traditional or electronic form. 1. The importance of chemistry in the national economy. 2. The development of the chemical industry in Uzbekistan. 3. Uzbek chemists. 4. The basic laws of chemistry. 5. Atomic structure. 6. D.I. Mendeleev's periodic law and the periodic table of elements. 7. Types of chemical bonds. 8. Structure of matter. The method of valence bonds and molecular orbitals. 9. Thermochemistry. 10. Chemical kinetics. Chemical reaction rate. 11. Chemical equilibrium. Equilibrium shift. 12. Water in nature. Water hardness. 13. Water hardness and methods of softening it. 14. Redox reactions. 15. Fundamentals of electrochemistry. 16. Batteries. Their types. 17. General properties of metals. 18. Metallurgical industry in Uzbekistan. 19. Alloys. 20. Corrosion of metals and methods of preventing it. 21. Characteristics of s-group elements. 22. p-elements. Their properties. 23. d-elements. Their properties. 24. d-elements of groups I-II (Cu, Zn, Ag, Au). 25. f-elements. Lanthanoids and actinoids. 26. Classification of organic compounds. 27. Saturated and unsaturated hydrocarbons. 28. Polymer chemistry and polymer materials. 29. Plastic masses, their importance in the national economy. 30. Mineral binders. Their importance in the national economy.
Exam form	Written
Teaching/learning and examination requirements	Complete mastery of theoretical and methodological concepts and practical knowledge of the discipline, the ability to correctly reflect the results of analysis, independently reason about the processes being studied and carry out tasks in the current, intermediate forms of control and independent work, pass written work on the final control. When drawing up final exam questions, deviations from the content of the discipline program are not allowed. The bank of final exam questions for each discipline is discussed at the meeting and approved by the head of the department. No later than 1 week before the start of the final control, tickets signed by the head of the department, enclosed in an envelope, are sealed by the Dean’s office and opened 5 minutes before the start of the exam in the presence of students. Final exam duration is 80 minutes. Answers to final exam questions are recorded in copybooks with the seal of the Dean’s office. After completion of the final work, the work is immediately encrypted by a representative of the Dean’s office, and the copybooks are handed over to the commission for verification. From the moment of completion of the final exam, a period of 72 hours is allotted for checking and posting the results on the electronic platform. The teacher who taught the students in this discipline is not involved in the process of conducting the exam and checking the students'

	answers. Student(s) who are dissatisfied with the final exam results may submit a written or oral appeal within 24 hours of the publication of the final exam results. Complaints submitted after 24 hours from the publication of the final exam results will not be accepted.
Scope of assessment criteria and procedure	CURRENT CONTROL Purpose: Determining and assessing the student's level of knowledge, practical skills, and competencies on course topics. Instructions: The student's activity in daily classes is assessed through the student's mastery of course topics, as well as constructively interpreting and analyzing the educational material, developing module-specific skills, acquiring practical skills (in terms of quality and the specified number) and competencies, solving problem situations aimed at applying professional practical skills, working in a team, preparing presentations, etc. Current control form: Activity in lessons Preparing educational materials Working with sources within the subject Using educational technologies Working in a team Preparing presentations Working with projects. MIDTERM CONTROL Purpose: Assessing the student's knowledge and practical skills and level of mastery of lecture material after completing the relevant section of the course. Form and procedure of intermediate control: Midterm examination is held during the semester during the training sessions after the completion of the relevant module of the curriculum of the subject. Midterm examination is held once in written form within the framework of this subject. Midterm examination questions cover all topics of the subject. INDEPENDENT LEARNING Purpose: Independent learning is aimed at fully covering the content of this course, expanding the theoretical knowledge acquired, and establishing independent learning activities for students. Form and procedure of independent education: independent work assignments are completed in the form of an educational project, presentation, case study, problem solving, information search, digest, colloquium, essay, article, abstract, etc. Completed assignments for independent study are placed in the electronic system and checked based on the anti-plagiarism program and evaluated by the subject teacher. In this case, the uniqueness of the completed assignment should not be less than 60%, otherwise the assignment will not be accepted for assessment. The number of independent work assignments, depending on the nature of the subject, should not be less than 3 for one subject (module). Independent work assignments account for 60% of the points allocated for current and intermediate control. FINAL CONTROL Purpose: The final examination is held at the end of the semester to determine the level of mastery of the student's theoretical knowledge and practical skills in the relevant subject. The final examination is held at a specified time according to the examination schedule created by the Registrar's Office on the electronic platform. Requirements: The student must have passed the current control, intermediate control and independent learning assignments by the deadline for the final control type in the relevant subject. A student who has not passed the current control, intermediate control and independent learning assignments, as well as who has received a score in the range of "0-29.9" for these assignments and control types, is not included in the final control type. Also, a student who has missed 25 percent or more of

	the classroom hours allocated to a subject without a reason is excluded from this subject and is not included in the final control type and is considered not to have mastered the relevant credits in this subject. A student who has not passed or was not included in the final control type and has received a score in the range of "0-29.9" for this type of control is considered to be an academic debtor. Final control form: The final examination in this subject will be conducted in written form. If the final examination is conducted in written form, the requirements for assessment must also be reflected.

Criteria for assessing student knowledge

5 grade	100 points		Assessment criteria
5	90-100	Excellent	When a student is considered to be able to make independent conclusions and decisions, think creatively, observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and have an idea about the subject.
4	70-89,9	Good	When the student is considered to be able to observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and has an idea about the subject.
3	60-69,9	Satisfactory	When the student is found to be able to apply the knowledge he has gained in practice, understands, knows, can express, and narrate the essence of the subject, and has an idea about the subject.
2	0-59,9	Unsatisfactory	When it is determined that the student has not mastered the science program, does not understand the essence of the subject, and does not have an idea about the science.

Course assessment criteria and procedure

Assessment type	Total points allocated	Control (task) form	Distribution of points	Qualifying score
Current assessment	30 points	System tasks	20 points (divided by the number of tasks)	18 points
		Student activity (in seminars, practical, laboratory classes)	10 points	
Midterm assessment	20 points	Supervision: Written work	10 points	12 points
		System tasks	10 points (divided by the number of tasks)	
Final assessment	50 points	Written assignment (5 questions)	50 points (10 points per question)	30 points
* Note: 60% of the points allocated for current and intermediate control are allocated to independent work assignments. Independent work assignments are evaluated as system assignments through the electronic platform.				

Recommended Literature	**Main literature:** 1. Axmerov Q.A. va boshqalar, Umumiy va anorganik kimyo, Darslik. T.: O'zbekiston, 2017. 226 b. 2. Parpiyev N.A. Muftaxov A.T., Raximov N.R., Anorganik kimyo, Darslik. T.: O'zbekiston, 2003. 215 b. 3. Н.Л. Глинка Общая химия: Учебное пособие - М.: Интеграл-Пресс, 2002. 732 с. 4. Ахметов, Н.С. Общая и неорганическая химия / Н.С.Ахметов. - М.: Высш. шк., 2001. - 743 с. 5. Soren Prip Beier & Peter Dybdahl Hede. Essentials of Chemistry. 2013. - 180 b. 6. И.К. Доманский Строительные материалы и изделия Учебное пособие Издательство Уральского университета 2018. 208 стр. 7. Е.И.Тупикин. Химия в строительстве Учебное пособие Москва: Юрайт 2019. 181 с. 8. Г.Г. Савельев, Л.М. Смолова Общая химия Учебное пособие Издательство Томского политехнического университета 2006. - 204 с. 9. Л.Г. Коляда, Л.Г. Тарасюк Химия Учебное пособие Магнитогорск 2015. 128 с. 10. Гаршин А.П. Общая и неорганическая химия в схемах, рисунках, таблицах, химических реакциях: Учебное пособие - СПб.: Питер 2011. - 288 с. 11. M.B.Matchanova, D.A.Xolmo'minova, S.Yu.Bobomuratova "Qurilish kimyosi" o'quv qo'llanma (qayta nashr). Jizzax-2023. 12. M.N.Pozilov, D.A.Xolmo'minova, A.A.Bo'riboyev. "Kimyo". Darslik. Toshkent-2022. 13. M.B.Matchonova. "Kimyo" Darslik. Toshkent-2022. **Additional literature:** 14. Sh.M.Mirziyoyev. Erkin va farovon demokratik O'zbekiston davlatini birgalikda barpo etamiz. - T.: O'zbekiston. 2016. 15. O'zbekiston Respublikasi Prezidentining "O'zbekiston Respublikasini yanada rivojlantirish bo'yicha Harakatlar strategiyasi" to'g'risidagi farmoni. Xalq so'zi gazetasi. 2017 yil 8-fevral. 16. Yoriyev O.M. va boshqalar. Umumiy va anorganik kimyodan masala va mashqlar to'plami. O'quv qo'llanma. T.: O'z.fay. MJ. 2008. -216 b. 17. Q.M.Ahmerov, S.M.Turobjonov, S.Y.Saparov Umumiy va noorganik kimyodan laboratoriya mashg'ulotlari o'quv qo'llanma. Toshkent, O'zbekiston, 2019. 18. A.M.Eminov, Sh.M.Xakberdiyev., I.R.Ro'zmatov., F.S.Karimova "Umumiy va anorganik kimyodan amaliy va laboratoriya mashg'ulotlari" o'quv qo'llanma. Toshkent-2021. 19. M.B.Matchonova. "Kimyo fanidan laboratoriya ishlari" Darslik. Toshkent-2023. **Internet resources:** 1. Elektron kutubxona ma'lumotlari. www.ziyonet.uz 2. Online publishing company of eBooks. www.bookboon.com 3. Alisher Navoiy nomidagi O'zbekiston Milliy kutubxonasi. www.natlib.uz 4. O'zbekiston Respublikasi hukumat portali. http://www.uzbekistan.uz 5. Online publishing. http://www.e-plastic.ru