Course title	Construction Chemistry **(ECTS 4)**
Topic/module code	QKIM1204
Semesters in which the course is taught	2 semesters
Assigned instructors	Khakberdiyev Shukhrat Makhramovich, Kurbanova Latofat Mamadiyorovna, Khamidov Sobir Khodiyevich
Language of instruction	Uzbek
Course type	Mandatory
Academic hours (including independent study)	**Total hours – 120.** **Classroom hours – 48** Lecture hours – 24 Laboratory hours – 12 Practical class hours – 12 **Independent study – 72 hours**
ECTS	4
Aims and objectives of the course / learning outcomes	**Aim of the course** – In order to deepen students' knowledge, the course "Construction Chemistry" directs students toward mastering the development of theories on the structure of matter (atoms and molecules) and the most important topics of construction chemistry. One of the main aims of the course is to study the distribution, composition and properties of natural resources and the processes of extracting the necessary substances from them, and the use of these substances in the construction industry (the course teaches the composition of binding materials (cement, gypsum, glass, ceramics, polymeric substances), their production, natural occurrence and chemical properties). **Objectives of the course –** to study the scientific and practical aspects of the course "Construction Chemistry"; to explain to students the great importance of construction chemistry in construction and in the national economy; to give general concepts of construction chemistry and to deepen students' knowledge of the significance of the course; and to teach the scientific and practical foundations of construction chemistry. Scientific methods, laws, hypotheses, theories and doctrines are used for this purpose. Teaching them is combined with the achievements and innovations being made in world science. **Learning outcomes:** 1. ***must have the skills*** to link the theoretical knowledge being studied with practice; 2. ***must have the skill*** of recognizing the interrelationships of the phenomena being studied and describing them objectively; 3. to know the laws and properties of chemistry and be able to use them; 4. in the process of preparing for classes on chemical compounds, to understand the program materials and ***to have a clear understanding of them.*** **Skills –** 5. Must have knowledge of the essence of the course "Construction Chemistry", atomic-molecular theory, inorganic compounds, their properties and significance in construction, the fundamental laws of

	chemistry, atomic structure, the energy state of electrons in the atom, quantum numbers and their physical meaning, the shapes of electron clouds, the periodic law and the modern interpretation and significance of the periodic table, and chemical bonding and its types. 6. Must have skills in thermochemical processes, exothermic and endothermic reactions, heats of formation and heats of dissolution of substances, thermal effects of reactions, Hess's law, enthalpy and entropy, Gibbs energy, chemical kinetics, reaction rate, factors affecting the reaction rate, homogeneous and heterogeneous catalysis, chemical equilibrium, solutions, the use of solutions in construction, the theory of electrolytic dissociation, hydrolysis of salts and the significance of hydrolysis. 7. To develop knowledge and skills concerning metals and their chemical properties, alloys, corrosion of metals, oxidation–reduction reactions, galvanic cells, the electromotive force of galvanic cells, storage batteries, electrolysis, the alkali metals of the periodic table, the elements of Groups II and III-A of the periodic table, water hardness, lime, cement, marble and their importance in the production of various construction materials, the elements of Group IV, compounds of silicon and carbon, their importance and use in construction, silicates, the elements of Group VIII-B and the use of their compounds in the construction field, the properties of polymers, plastics, rubbers and adhesives, their use and importance in construction, in municipal and household use, in the economy and in the paint-and-varnish industry, and binding materials and their use in construction and other fields.
Course content (topics)	**I. Main part (Lectures)** **Topic 1:** Introduction to Construction Chemistry. Inorganic compounds and their importance in construction. **Topic 2:** Basic laws of chemistry. **Topic 3:** Atomic structure. Chemical bonding. **Topic 4:** Thermochemical processes. **Topic 5:** Reaction rate and chemical equilibrium. **Topic 6:** Solutions, colloids, dispersions and emulsions. Electrolyte solutions. **Topic 7:** General properties of metals. Electrochemical processes. **Topic 8:** Elements of Groups I and II A and their importance in construction. **Topic 9:** Elements of Groups III and IV A and their use in the construction field. **Topic 10:** Elements of Group VIII B of the periodic table and their use in construction. **Topic 11:** High-molecular compounds. **Topic 12:** Binding materials. **II. Instructions and recommendations for practical classes** **Semester 1 (12 hours)** The aim of the practical class is to understand the theory and to acquire skills. It consists of developing the ability to apply it consciously in academic and professional activity and to form one's own point of view convincingly. 1. Solving examples on inorganic compounds. 2. The basic laws of chemistry and solving example problems based on them. 3. Electron orbitals in the atom. Quantum numbers, electronic formulas of

chemical elements. Studying the types of chemical bonding and solving examples.

4. Solving problems on thermochemical processes.
5. Reaction rate. Studying the factors affecting the rate of a chemical reaction. Solving problems.
6. Methods of expressing the concentration of solutions. Studying oxidation–reduction reactions through examples and solving problems.

III. Instructions and recommendations for laboratory classes:

Semester 1 (12 hours)

1. Safety rules and rules of work in chemistry laboratories; getting acquainted with the instruments and equipment used; weighing on a balance. Preparation and chemical properties of inorganic substances.
2. Determining the gram-equivalent mass of a metal (Mg) by the volumetric method and studying it by the interactive method.
3. Thermochemistry. Experimental determination of the heat of dissolution of salts.
4. Chemical kinetics. Factors affecting the rate of a chemical reaction. Chemical equilibrium.
5. Preparing a solution. Experimental determination of the concentration of solutions from their density (hydrometer). Methods of expressing solution concentration.
6. The effect of the medium on the course of oxidation–reduction reactions. Conducting experiments on the laboratory production of liquid glass.

Students consolidate the theoretical knowledge gained in the course lectures during educational laboratory classes. The student performs the laboratory work under the supervision of a laboratory assistant, prepares the report and submits it to the course instructor.

IV. Independent study and independent work.

Semester 1 (72 hours)

The independent study competence helps students with independent self-development and serves to increase the effectiveness of professional activity. Students carry out independent work on their own mobile devices under the guidance of the instructor, in traditional or electronic form.

Independent study on the recommended topics:

1. Elements of Group I A of the periodic table. Properties of K and Na and their importance in construction.
2. Preparation and properties of the elements of Group I B of the periodic table (using Cu – copper as an example).
3. Properties and uses of the elements of Group II B of the periodic table (Zn – zinc, Cd – cadmium).
4. Studying the properties and uses of the elements of Group V A of the periodic table (P – phosphorus, N – nitrogen).
5. Preparation, properties and uses of the elements of Group VI A of the periodic table (O – oxygen).
6. Properties and uses of the elements of Group VIII B – the secondary subgroup – of the periodic table (Fe – iron, Co – cobalt, Ni – nickel).
7. Properties and uses of the elements of Group IV A of the periodic table (Pb, Sn).
8. Chemical processes. Energetics of chemical processes. Thermal effect of a chemical reaction.
9. Methods of obtaining salts.
10. Physical and chemical properties of water.
11. Hardness of water and methods of eliminating it.
12. Chemical compounds used in cement production.
13. Chemical compounds used in glass production.

	14. Corrosion of metals and methods of preventing it. 15. High-molecular compounds used in construction. 16. Brick production. 17. Construction chemistry and its environmental problems.
Student assessment	**a) To receive a grade of 5, the student's level of knowledge must meet the following requirements:** **>** if the student can fully explain the essence and content of the course; > if, in presenting the topics of the course, scientific rigor and logic are maintained and no scientific errors or confusion are allowed; > if the student has a clear idea of the theoretical or practical significance of the course topic materials; > if the student can demonstrate the ability to think independently and freely within the scope of the course; > if the student can give precise and concise answers to the questions asked; > if the student has prepared lecture notes thoroughly; > if the student has completed the independent assignments fully and accurately; > if the student has mastered all practical skills and competencies; > the ability to apply theoretical knowledge in various situations; > taking a systematic approach and observing consistency and continuity. **b) To receive a grade of 4, the student's level of knowledge must meet the following requirements:** **>** if the student has understood the essence and content of the course and, in presenting the course topics, does not allow scientific or logical confusion; > if the student has understood the practical significance of the content of the course; > if the student completes the tasks and assignments given in the course within the scope of the curriculum; > if the student can answer the questions on the course correctly; > if the student has thoroughly compiled the lecture notes for the course; > if the student has fully completed the independent assignments for the course; > if the student has tried to master all practical skills and competencies; > if the student has tried to master all practical skills and competencies. **c) To receive a grade of 3, the student's level of knowledge must meet the following requirements:** **>** if the student has a general understanding of the course; > if the topics of the course are covered within a narrow scope and some confusion is allowed in the presentation; > if the student has fully completed the independent assignments for the course; > if the presentation is not fluent; > if the answers to questions on the course are vague and confused; > if the text on the course is not thoroughly prepared. **d) The student's level of knowledge may be assessed as unsatisfactory, grade 2, in the following cases:** **>** if the student has not prepared for classes in the course; > if the student has no idea at all about the course classes; > if the student has not fully completed the independent assignments for the course; > if it is evident that the texts for the course were copied from others; > if serious errors and confusion are allowed in the text on the course;

	> if no answers are obtained to the questions on the course, i.e., the student does not know the course.
Requirements for examinations	The student must have fully mastered the theoretical and practical concepts on the topic and be able to reflect the results of analysis correctly. The student must have completed the assignments given in independent work and in the continuous and midterm forms of assessment. In addition, within the established time, the student must have obtained sufficient scores in the continuous, midterm, independent study and final assessments in the relevant course. A student who has not submitted the assignments of the continuous assessment, midterm assessment and independent study, or who has earned fewer than 30 points in these assignments and types of assessment, is not admitted to the final assessment. Likewise, a student who misses 25 percent or more of the classroom hours allocated to the course without a valid reason is excluded from the course, is not admitted to the final examination, and is considered not to have earned the corresponding credits for this course. A student who fails the final examination or earns a score in the range "0–29.9" in examinations of this type is considered to have an academic debt.
Recommended literature	**Main literature** 1. A.A. Abdurakhimov. "Qurilish kimyosi" [Construction Chemistry]. Textbook. – Tashkent: TAQI, 2020. – 375 pp. (in Uzbek) 2. M.B. Matchanova, S.Yu. Bobomuratova. "Qurilish kimyosi" [Construction Chemistry]. Textbook. Jizzakh, 2023. – 340 pp. (in Uzbek) 3. S.Kh. Zokirov, Z.Sh. Mukhidova. "Qurilishda organik va fizik kimyo" [Organic and Physical Chemistry in Construction]. Tashkent, 2018. (in Uzbek) 4. M.N. Pozilov, Ya.I. Gulboyev, A.A. Buribaev. "Yo'l qurilish materiallari kimyosi" [Chemistry of Road Construction Materials]. Textbook. – Tashkent: JizPI Printing House, Jizzakh, 2026. – 281 pp. (in Uzbek) **Additional literature** 1. Z.A. Mukhamedbayeva, M.Kh. Aripova, A.A. Mukhamedbayev, T.A. Otaqo'ziyev, E.I. Kurbanov. "Sement va beton kimyosi" [Chemistry of Cement and Concrete]. Study guide. Tashkent Institute of Chemical Technology. – Tashkent: Fan Ziyosi, 2022. – 248 pp. (in Uzbek) 2. J.N. Shermamedov. "Organik qurilish materiallari va buyumlari" [Organic Construction Materials and Products]. Study guide. Tashkent: "O'zbekiston", 2002. – 189 pp. (in Uzbek) 3. T.V. Ganieva, A.I. Abdulin, M.R. Idrisov. "Sovremennye dorozhno-stroitelnye materialy" [Modern Road-Construction Materials]. Study guide. Prospekt Nauki, 2014. – 144 pp. (in Russian) 4. M.K. Abdumavlyanova. "Polimerlar kimyosi va texnologiyasi, hamda ularni sinash" [Chemistry and Technology of Polymers and Their Testing]. Study guide. Tashkent: "Shafoat nur fayz", 2022. – 224 pp. (in Uzbek) **Internet (information) resources** 1. Electronic library data: www.ziyonet.uz; www.natlib.uz 2. https://api.ziyonet.uz/uploads/books/456901/5add7a238b965.pdf 3. https://www.researchgate.net/publication/364197276_Yo'l_qurilish_

materiallarini_ishlab_chiqarishda_xom-ashyo_materiali_sifatida_chiqindilardan_foydalanish

4. https://cyberleninka.ru/article/n/sementbeton-qoplamali-avtomobil-yo-llarini-saqlash-texnologiyalarini-takomillashtirish-orqali-ularning-xizmat-muddatini-oshirish

5. Yao H., You Z., Li L. Fourier Transform Infrared (FTIR) Spectroscopy Characterization of Asphalt Binders Modified with Nanoclay//*Construction and Building Materials*, Vol. 35, 2012. – pp. 312-320.

6. Hewlett, P., Liska, M. (eds.). Lea's Chemistry of Cement and Concrete Butterworth-Heinemann, 5th edition- 2019. 868p. https://books.google.co.in/books?id=bpmLDwAAQBAJ&printsec=copyright#v=onepage&q&f=false

7. Construction Materials: Their Nature and Behaviour, 3rd ed. Edited by J . M . Illston and P . L . J . Spon Press 2001, Print ISBN: 978-0-419-25860-5 eBook ISBN: 978-0-203-47898-1 3rd ed. is free for the TU Delft students at: http://www.crcnetbase.com/isbn/978-0-419-25860-5