THE REPUBLIC OF UZBEKISTAN
MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATIONS

URGENCH STATE UNIVERSITY

"APPROVED"
Rector of University
_____ B.I.Abdullaev
2024 year "28" 08

Registered: № BD60710100 - 1.21
2024 year "28" 08

FUNDAMENTALS OF MINERALOGY, CRYSTALLOGRAPHY AND CRYSTALLOCHEMISTRY

CURRICULUM

Field of knowledge:	700 000 – Engineering, processing and construction
Field of education:	710 000 – Engineering
For the majors:	60710100 - Chemical technology (processing and construction, organic vs inorganic materials)

Urganch - 2024

INFORMATION ABOUT SUBJECT

Subject/Module code MKKAB351	Education year 2024-2025	Semester 5	ECTS - Credit 5
Subject/Module type Mandatory	Subject Language English		Weekly class hours 4

	Subject name	Audience education (hour)	Independent education (hour)	Total education (hour)
1.	Fuundametals of Mineralogy crystallography and crystallochemistry	60	90	150

2. **I. The content of subject**

"This subject provides theoretical knowledge in the field of "Fundamentals of mineralogy, crystallography and crystallochemistry". Necessary knowledge for solving the content of technological processes. Especially types of minerals, their composition and structure, formation conditions, symmetry theory of crystals, symmetry classes and elements, mineralogical and chemical composition of minerals used in the technology of silicate materials. The task of subject is to introduce the types and structure of minerals and their place in production, their characteristics, to learn to determine the symmetry classes of crystals, to use modern technologies in the identification of minerals, as well as theoretical and practical knowledge. is to achieve the ability to apply skills and qualifications in professional activities.

3. **II. Main educational part (Lecture classes).**

II.I. Suggested topics:

1. Introduction. Crystallography, mineralogy, crystallochemistry, petrography.

Composition of minerals, structure and other properties of materials. Contributions of Uzbek scientists to the development of crystallography, mineralogy and crystallochemistry.

2. Theory of symmetry of crystal.

32 classes of symmetry. Upper, middle and lower categories, syngonias and their appearance. Forms of multifaceted crystals. 47 simple forms of upper, middle and lower categories. Spatial grid, elementary cell. 14 Brave bars. 230 Fyodorov space groups.

3. An island, chain, layered, frame, and other crystal structures and their important views.

Internet information:

1. www.techologiy.ru
2. www.google.com
3. www.ziyonet.uz
4. www.google.uz
5. www.chemport.ru
6. www.ximik.ru

8. According to the report No. 1 of August 28, 2023 of the Coordinating Council for the Activities of Educational and Methodological Associations in Higher Education Areas and Specialties of the Science Program. Approved by the report No. 1 of August 28, 2023 of the Coordinating Council for the activity of methodical associations.

9. **Responsible person for subject/module:**
Allabergenov Bunyod Farxodovich, Doctor of philosophy of School of Advanced Materials Science and Engineering (PhD), Jumaniyozov Arslon G'anibek o'g'li, Department of Chemical Technology, Urgench State University.

10. **Reviwers:**
X.P. Jumaniyazov – Doctor of philosophy of Chemical Engineering, Department of Chemical technology, Urgench State University
N.K. Saparbayeva - Doctor of philosophy of Chemical Engineering, Department of Chemical technology, Urgench State University

This curriculum was approved by the minutes of the meeting of the University Educational and Methodical Council on 29.08., 2024.

This curriculum was approved by the minutes of the meeting of the "Chemical Technologies" department on 29.08. 2024.

Academic activities and registrar department head: _____ Signature **G. Matlatipov**

Dean of the faculty: _____ Signature **Kurambayev Sh.R.**

Head of the department : _____ Signature **Aitova Sh.K.**

Developers : _____ Signature **Allabergenov B.F.**

_____ Signature **Jumaniyazov A.G'.**

7.

REFERENCES

1. Zohidov K.S. Kristallografiya. O'kuv qo'llanma. Toshkent: O'zbekiston, 2003, -256 b.
2. Кристаллография и минералогия : учеб.-метод. пособие / В. В. Сергеева. — Екатеринбург : Изд-во Урал. ун-та, 2017. – 152 с.
3. Odilxonov K.N. Mineralogiya: o'quv qo'llanma. Qayta ishiangan va to'ldirilgan ikkinchi nashr / K.H.Odilxonov; nashr uchun mas'ul M.A.Mirusmonov; O'zbekiston Respublikasi Oliy va o'rta maxsus ta'lim vazirligi; Abu Rayhon Beruniy nomidagi Toshkent Davlat texnika universiteti: O'zbekiston Respublikasi geologiya va mineral resurslar davlat qo'mitasi; «Mineral resurslar ilmiy-tadqiqot instituta» Davlat korxonasi. - T.: «Mineral resurslar ilmiy-tadqiqot instituti» Davlat korxonasi, 2014. - 466 b.
4. Qodirov M.X., Shoraximov Sh.Sh. Geologiyadan amaliy mashg`ulotlar. O`quv qo`llanma. Toshkent: O`zbekiston, 1994.-204 b.
5. Лос М.М. Кристаллография и минералогия. Учебное пособие. Новочеркасск: изд. НПИ, 1986. -188 с.
6. Tursunov X. Tuproq minerologiyasi. O'quv qo'llanma. Toshkent: O'zbekiston. 2000.-128 b.

ADDITIONAL REFERENCES

1. Mirziyoev SH.M. Buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz. - T. "O'zbekiston", 2017. - 488 b.
2. Mirziyoev SH.M. Qonun ustuvorligi va inson manfaatlarini ta'minlash-yurt taraqqiyoti va xalq farovonligining garovi.- T. "O'zbekiston", - 2017. - 48 b.
3. Mirziyoev SH.M. Erkin va farovon demokratik O'zbekiston davlatini birgalikda barpo etamiz. - T. "O'zbekiston", 2016. - 56 b.
4. Ismatov A.A. Silikat va qiyin eriydigan nometall materiallar fizik-kimyoviy taxlilning zamonaviy usullari. O'quv qo'llanma Toshkent: Fan va texnologiya, 2006.-272 bet.
5. Sovremennaya kristallografiya Tom 4. Fizicheskie svoystva kristallov. Uchebnoe posobie. – M.: Nauka, 1981. -484 s.
6. Smolegovskiy A.M. Istoriya kristalloximii fosfatov. Uchebnoe posobie. – M.: Nauka, 1986. -261 s.
7. SHefranovskiy I.I. Osnovы kristallografii. Uchebnoe posobie. – M.: Nauka, 1984. -116 s.
8. Perepelitsin V.A. Osnovы texnicheskoy mineralogii i petrografii. Uchebnoe posobie. – M.: Nedra, 1987 g.

Structure and structural type of crystals, atomic and ionic radis. Coordination number and its types and properties. Types of chemical bonds in crystals. Study of mechanical, optical and other properties of crystal materials.

4. Morphology, properties of minerals, their composition, and structure dependence.

Discovery of mineral forms in nature. Habitat of natural and artificial minerals.

5. Natural pure elements, sulfides, halogens, oxides and hydroxides, carbonates, sulfates, phosphates, borates, and silicates.

Division of sexes according to genesis. Magmatic, sedimentary and metamorphic rocks.

6. Compositions of earth minerals.

Chemical, mineralogical composition, structure and texture of rocks. Scientific works of Greig and Belov.

7. The main structural purpose in the structure of metals and metal alloys.

Formation of electronic equipment materials. Examples explaining the structure of metals and metal alloys.

8. Anion radical size - island, ring and other silicates.

Infinite anion radical size - chain, band and framework silicates. Classification bases and signs.

9. Polymorphism and isomorphism.

Types of polymorphism. Isomorphism formation condition. Isovalent and heterovalent isomorphism.

10. Scheme of polymorphic transformations of silica and alumina.

Distribution of silica and alumina in nature. Appearances of silica - veined quartz, quartz sand, dusty quartz, fine fiber-chalcedony and colloid - opal, quartz glass. Natural hydrates and minerals of glinozem. Crystallographic modifications of glinozem. Polymorphic changes of glinozem.

III. Instructions and recommendations for practical classes.

Suggested topics:

1. Contributions of Uzbek scientists to the development of the science of mineralogy. Determining the crystallographic description of simple forms.
2. Analysis of the properties of minerals.
3. Aggregate state of substance. State of crystallinity. The main properties of crystalline substances.

4. The structure of solid (glass) in the cooled amorphous state. Conditions of transition of amorphous solids to crystalline state.
5. Names, formulas, and diagnostic properties of minerals.
6. Chemical and mineralogical composition of quartz, calcite, magnesite, borax, dolomite, kaolin, soda, potash, porphyry, perlite, talc and other minerals.
7. Determining the structure of crystals using microscopic and X-ray methods.
8. Derivation of concepts of polymorphism and isomorphism. Works of Mitscherlich, Gold Schmidt on isomorphism.

IV. Instructions and recommendations for laboratory classes.

Suggested topics:

1. Determination of crystallographic dimensions of minerals.
2. Determination of refractive index of minerals.
3. Determination of specific gravity of minerals.
4. Determination of hardness properties of minerals.
5. Determining the degree of melting point of minerals.

Laboratory classes are held in the modular system and auditoriums equipped with multimedia devices.

V. Independent education and trainings.

Suggested topics:

1. Mineral raw material base of silicate and electronics industry.
2. Connection of crystals. Doubles. Laws of duality in different syngonias.
3. Application of X-ray structural analysis in structural crystallography.
4. Polymorphism and isomorphism. Basic rules of isomorphism.
5. Role of metal alloys and silicates in crystal formation.
6. Mineral aggregates, druses, spherulites, forms, etc. Secondary duality.
7. Use of rocks in the production of silicate materials.
8. The occurrence of quartz, calcite, magnesite, borax, dolomite, kaolin, soda, potash, porphyry, perlite, talc and other minerals used in the glass industry. Increasing the strength of silicate products.
9. Important silicates used in the production of ceramics and glass materials.
10. Specific structure of conductor, semi-conductor, dielectric, magnetic materials.
11. Anion radicals - SiO_4, Si_2O_7, Si_mO_{3m}, SiO_3, Si_4O_{11}, Si_6O_{17}, Si_2O_5, $Al_m Si_{n-m}O_{2n}$
12. Important metals and alloys used in technology.
13. Isomorphism in silicates and metals. Management of structure and properties by isomorphism.
14. The essence of the crystallographic concept. Symmetry axis, plane and

center.

15. Studying the structure of simple crystals - rhombic prism, trigonal pyramid, tetragonal bipyramid, hexagonal prism, hexahedron, octahedron, rhomb dodecahedron, etc.
16. Creating a description of the properties of rock-forming minerals.

It is recommended to prepare abstracts and present them by students on subjects to be mastered independently.

4. **VI. Results of science education (competencies to be formed)**

As a result of learning the subject, the student:

- Symmetry theory of crystals;
- Symmetry elements and classes, their composition and structure;
- Categories and syngonias;
- Rules for writing symmetry classes in international symbols;
- To have an idea and knowledge about the forms of multifaceted crystals and the laws of growth sequence;
- Understanding of minerals, their composition and structure;
- Forms of volatile minerals in nature, laws of habitus growth;
- Formation conditions and aggregate states of minerals;
- Minerals (sand, calcite, magnesite, borax, dolomite, kaolin, soda, potash, porphyry, perlite, talc, etc.) used in the production of ceramics, glass and steels are classified according to their mineralogical and chemical composition. to have skills;
- Technical and economic analysis of studied and used minerals, rocks;
- Using them effectively in specific conditions;
- Must have the skills to determine the mass composition of minerals and rocks based on their optimal parameters.

5. **VII. Educational technologies and methods:**

- lectures;
- individual assignments;
- team work;
- perform practical work based on a real situation;
- execution of project work;
- perform independent work

6. **VIII. Requirements for obtaining loans:**

Full mastery of theoretical and methodological concepts related to science, ability to correctly reflect the results of analysis, independent observation of the studied processes, and completion of tasks and assignments given in the current and intermediate control forms, written on the final control submit work.