Syllabus

1. Name of module (discipline) Chemistry 1.1, 2.1. (General and Inorganic Chemistry)

2. Specializations:
18.03.01 Chemical technology
18.03.02 Energy and resource saving processes in chemical technology, petrochemistry and biotechnology
19.03.01 Biotechnology
18.05.02 Chemical technology of modern energy materials

3. QUALIFICATION (DEGREE) academic bachelor, engineer

4. COURSE__1_____ SEMESTER ____1, 2____

5. THE NUMBER OF CREDITS __10 (6/4)____
Code of discipline:. DISC BM5

6. Providing division ___Department of chemistry and chemical technology_____

7. Lecturer: Andrey V. Korshunov, tel. 606166, e-mail: korshunov@tpu.ru

8. The learning outcomes of the discipline
RD1- to apply knowledge of general laws, theories, equations, techniques of chemistry when studying chemical processes
RD2- toperform calculations (stoichiometric, thermodynamic, kinetic, electrochemical, calculation of concentration of solutions) when carrying out chemical processes
RD3 - to use experimental procedures for the production, study of properties of chemical compounds, to perform qualitative and quantitative analysis of substances, the purification of substances from impurities.
RD4 - to perform processing and analysis data obtained from theoretical and experimental studies
As a result of learning discipline student should be:
To know:
• electronic structure of atoms and molecules;
• fundamentals of the theory of chemical bonding in compounds of different types, structure and properties of coordination compounds, structure of matter in the condensed state;
• main regularities of the course of chemical processes and the characteristics of the equilibrium state;
• methods for describing chemical equilibria in solutions of electrolytes;
• chemical properties of elements from different groups of the Periodic system and their compounds;
Be able to:
• perform basic chemical operations;
• to determine thermodynamic characteristics of chemical reactions and equilibrium concentrations of substances;
• use basic chemical laws, thermodynamic reference data and quantitative ratios of inorganic chemistry for the solution of professional tasks;
• analyze and process experimental data.
To possess:
• theoretical methods of description of properties of simple and complex substances on the basis of

the electronic structure of atoms and their position in the Periodic system of chemical elements;
• experimental methods of determination of physical-chemical properties of inorganic compounds.
The students develop the following competences:
Cultural competence (CC)
CC-1 Possession of culture of thinking, to be able to generalize, analysis, information perception, goal setting and choice of ways of its achievement;
CC-2 Skill logically correct, reasoned and clearly build oral and written speech, to be able in writing and speaking correctly (logically) to obtain the results of thinking;
CC-7 Desire for self-development, improve their qualifications and skills, to acquire new knowledge in the field of engineering and technology, mathematics, natural, human, social and economic Sciences;
Professional competence (PC)
PC-1 The ability and willingness to use basic laws of natural-science disciplines in professional activity, to apply methods of mathematical analysis and modeling, theoretical and experimental research;
PC-2 Using knowledge of the modern physical world picture, space-time patterns, structure of matter to understand the surrounding world and natural phenomena;
PC-8 Ownership of experimental design, processing, and presentation of the results.

9. The content of the discipline.
Semester 1. 1.1 chemistry (General chemistry)
Section I. Basic laws and concepts of chemistry
Subject and problems of chemistry, its methods and main stages of its development. The subject of general chemistry. The essence of the systemic-structural approach to the study of chemistry. The history of the formation of classical chemistry. Atomic-molecular doctrine and the stoichiometry. Classification and nomenclature of inorganic substances. Oxidation-reduction reactions.
Lecture 1. Basic laws and concepts of chemistry
Practical class 1. The main classes of inorganic compounds. Atomic-molecular doctrine. Stoichiometric calculations
Laboratory work 1. The main classes of inorganic compounds
Section II. Structure of matter
The structure of the atom and the periodic system of elements by D. I. Mendeleev. Chemical bonding and molecular structure. Main types and characteristics of chemical bonds: length, energy, bond angle, dipole moment, magnetic properties. The complex compounds.
Lecture 2. The structure of the atom. The state of electrons in atoms
Lab 2. The main classes of inorganic compounds
Lecture 3. The periodic law and the periodic system of chemical elements
Practical class 2. The structure of the atom and the Periodic law
Laboratory work 3. Determination of the hydrated compoundformula
Lecture 4. The main types of chemical bonds. Covalent bond. Methods of Valence Scheme(VS) and molecular orbitals (MO).
Laboratory work 4. Determination of equivalent and atomic weight of the metal
Lecture 5. Chemical bonding in ionic compounds and metals. Structure of substances in the condensed state
Practical class 3. Chemical bond, structure of molecules
Lecture 6. The chemical bond in complex compounds
Laboratory work 6. Complex compounds
Section III. Patterns of chemical reactions
Energetics of chemical reactions. Chemical equilibrium. Chemical kinetics.

Lecture 7. The first thermodynamics law of. Hess's Law. The second thermodynamicslaw .
Practical class 4. Energetics of chemical reactions
Laboratory work 7. The thermal effect of dilution
Lecture 8. Chemical equilibrium
Laboratory work 8. Definition of heat capacity and entropy of metal
Lecture 9. Chemical equilibrium
Lecture 10. The rate of chemical reactions
Practical class 5. The rate of chemical reactions
Laboratory work 9. The rate of chemical reactions
Lecture 11. Factors affecting the rate of reactions
Laboratory work 10. Heterogeneous reactions
Section IV. Solutions
General regularities of dissolution, the solutions of nonelectrolytes. The electrolyte solutions. Ion-exchange reactions and hydrolysis of salts.
Lecture 12. Disperse systems, classification. Solutions, concentration of solutions.
Practical lesson 6. Ways of expressing concentrations of solutions
Laboratory work 11. Preparation of the solution and determination of its concentration
Lecture 13. Solutions of nonelectrolytes
Laboratory work 12. Determination of water hardness
Lecture 14. Solutions of electrolytes
Practical class 7. Properties of solutions
Laboratory work 13. The reactions of ion exchange
Section V. Electrochemical system
Chemical equilibrium at the metal-solution interface. A number of electrochemical activity (number of voltages) of metals. Galvanic cells. Electrolysis. Corrosion.
Lecture 15. The electrochemical system. Galvanic cells
Laboratory work 14. Hydrolysis of salts
Lecture 16. Electrolysis
Practical class 8. Electrolysis
Laboratory work 15. Electrolysis
Lecture 17. Corrosion of metals
Laboratory work 16. Corrosion of metals

Semester 2. 2.1 chemistry (Inorganic chemistry)
Section 1. General regularities in inorganic chemistry
The subject inorganic chemistry and its practical significance. Chemical elements on Earth: common, rare, absent-minded, noble, radioactive, artificial. Simple substances. The frequency of change of their properties with increasing atomic number of the element. Changing of the acid-base properties of the compounds depending on their composition and structure (by the example of binary compounds (oxides, hydrides, halides, etc.), acids, bases and salts).
Lecture 1. General regularities in inorganic chemistry. Halogens
Practical class 1. General laws in neorganic chemistry
Laboratory work 1. Reaction of metals with acids and alkalis
Section 2. Main groups of the periodic table
The electronic structure of atoms, common characteristics of the elements, the patterns of changes in physico-chemical properties of simple substances and compounds. Application in the national economy. The problems of technology and ecology.
Hydrogen and the Halogens. The chalcogens. The p -elements of the fifth group. The p-elements of the fourth group.

Elements of the third group. Chemistry of s-elements.
Lecture 2. The chalcogens
Lab 2. Halogens
Lecture 3. The p- elements ofVgroup
Practical class 2. Hydrogen and the Halogens
Laboratory work 3. Sulfur
Lecture 4. The p- elements of IVgroup
Laboratory work 4. Synthesis of $Na_2S_2O_3$ and its properties
Lecture 5. Then p-elements of IIIgroup
Practical lesson 3. The chalcogens
Laboratory work 5. Nitrogen
Lecture 6. s-Elements
Laboratory work 6. Phosphorus, antimony, bismuth
Section 3. Transition elements
Position in the periodic table; electronic structure, radii and ionization energy of atoms; the degree of oxidation; complexing properties (over decades and sub-groups), comparison with p-elements. Natural compounds, classical and new ways of producing. Thermodynamic basis for the reduction of metals from oxides and salts, methods of refining. The properties of simple substances (the ratio of the non-metals, water, acids and alkalis, the position in a number of stresses, melting and boiling points, hardness), the regularities of their changes over the decades and sub-groups. Classification of metals. General regularities of changes in basic-acidic and redox properties of the compounds of d-elements.
Lecture 7. The elements 3B and 4B of the groups
Practical class 4. The p elements of V group
Laboratory work 7. Carbon, silicon, tin, lead
Lecture 8. The elements of 5B-7B groups
Laboratory work 8. 1A group, 2A group
Lecture 9. The group 8B elements
Practical class 5. p-Elements of III and IV groups
Laboratory work 9. Boron, Aluminum
Lecture 10. Elements 1B and 2B groups
Practical class 6. s-Elements
Laboratory work 10. Chromium, Manganese
Lecture 11. The family of f-elements
Practical class 7. Transition metals
Laboratory work 11. Iron, cobalt, Nickel
Lecture 12. Noble gases
Practical class 8. Transition metals
Laboratory work 12. Copper, silver, zinc, cadmium

10. Course_1____ semester ___1,2 _____ number of credits __10___

12. Prerequisites __no_____

13. The co-requisites___ecology_____

14. Type of assessment (examination, test)_____ exam _____

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