**Course Program of "The physical chemical fundamentals of natural process’s unity"**

**Staff Member Responsible for the course:** Prof., Dr. of Chemical Sciences Lukov Vladimir Victorovich, Professor of the Department of Chemistry of Southern Federal University.

1. **The name of the educational program in which the discipline is read.**

The discipline "The physical chemical fundamentals of natural process’s unity" is delivered in the framework of the Master's program "Human ecology with fundamentals of biomedicine" in the direction of training 06.04.01 "Biology", master’s degree level.

1. **The overall complexity.**

The total complexity of the discipline is 5 credit units, 180 hours. The program of the discipline provides:

The fall semester of the 2nd course: lectures-36 hrs., seminars-36 hrs., student individual work-108 hrs.

1. **The place of discipline in the structure of the educational program.**

The discipline "The physical chemical fundamentals of natural process’s unity" concerns to the variable part of the block of disciplines.

In order to learn the discipline the following knowledge and skills are necessary: mathematics, physics, structure of substances, computational methods in chemistry, physical chemistry

1. **The purpose of studying the discipline.**

The aim of the discipline “The physical chemical fundamentals of natural process’s unity” is the creation of representations about the uniform physical and chemical basics determining the development of natural processes. From this point of view the versatile characteristics of the processes proceeding both on the Earth, and in space are delivered. The question of science development’s influence on both the Earth state and ecosystems is considered. Threat of ecological crisis and how it can be overcome are also considered. From these positions the modern trends in green chemistry, nanotechnologies using molecular mechanisms of chemical reactions, application of supercritical technologies are shown. Besides these ideas the new representations in the chemistry, appeared at the end of XX century, the new structures, new methods of research are considered.

1. **Requirements for the results of mastering the discipline**

In accordance with the federal state educational standard of higher education in the direction of training 06.04.01 Biology (master’s degree level) discipline is aimed at the formation of the following competencies:

readiness to use fundamental biological ideas in the field of professional activity for setting and solving new problems

the ability to creatively use in the scientific and industrial-technological activity knowledge of the fundamental and applied sections of the disciplines (modules) that determine the direction (profile) of the graduate program;

the ability to plan and implement professional activities (in accordance with the orientation (profile) of the graduate program)

**As a result of mastering the discipline, the student must:**

**know:**

The basic achievements of a chemical science in XX century.

The fundamentals of green chemistry. The representation of this approach as new chemist’s thinking.

The fundamentals of nanochemistry. A history of development.

The characteristic of nanoparticles, nanosubstances and nanocomposites.

The most outstanding achievements of chemical synthesis of XX century.

Structure of Solar system, internal and external planets, zone of asteroids and Cooper zone.

 The representation about the sun as a gas sphere. Thermonuclear processes in a center of the Sun.

Origin of chemical elements. Explosions of nova and supernova stars. An origin of the universe. The theory of the Big bang.

**be able to:**

gather and analyze subject literature;

explain the theoretical details and interrelation between physical, chemical and biological processes, creation and development of new perspective materials and chemical technologies, the solving fundamental and applied problems in chemistry and chemical technology with reference to “ Green chemistry ”);

explain the formation and destruction of star systems. Solar system and galaxies.

To illustrate the main features of nanoparticles, nanosubstances and nanocomposites as well as nanotubes. To show the perspectives of nanotechnology development and possible threats.

**Have skills:**

How to prevent and remove the threat of extreme situations under manipulation with dangerous waste products

Surrounding natural environment monitoring.

The save handling with dangerous chemical and radioactive waste products in the chemical industry.

To have the knowledge about the stars as a gas sphere. Approximation} of “ideal gas”. Theoretical methods of an estimation of temperature in center of stars. Exotic stars - white dwarfs and neutron stars, their characteristics.

Hypothesis of “the Big bang” and model of the extending universe. An origin of chemical elements.

Asteroids and comets, the purpose is the Earth?

The mankind and ecology. Cosmological aspects of terrestrial civilization development.

**The content of the discipline "The physical chemical fundamentals of natural process’s unity" is built on a modular principle, with two main modules.**

**1. «Chemistry of XX century»**

The basic achievements of the XX century chemistry of. Ecological threats and a problem of environment preservation. Green chemistry - one of ways of chemical risk’s reduction. Inversion of traditional classification of chemical sciences and new hierarchy of the general chemistry problems. « Silent revolution » in chemistry

 **2. « The Century of nanotechnologies. «Thermodynamics of the universe»**

Attempts of transferring to a molecular technological level. Devices at a molecular and atomic level. Molecular and quantum computers. The nanochemistry and the nanotechnology. Iridescent prospects and inconsistent forecasts. Supercritical state of substance. New technologies. A role of chemical synthesis. Oustanding molecules. What innovations the coordination chemistry brings in understanding the chemical nature of substances. Formation and destruction of star systems. Solar system and galaxies.

**Basic educational technology**

Discipline teaching provides the following forms of organization of the educational process: score-rating system of knowledge assessment during the current control, mid-term control and intermediate certification, interactive lectures, independent student work, testing, project method, presentation method.

**Forms of control**

The discipline program provides for the following types of control: monitoring progress in the form of a test, a report with a presentation and a project assignment, mid-term monitoring of progress in the form of testing, intermediate control in the form of an exam.

**GRADING SCHEME**

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| A | EXCELLENT - outstanding performance with only minor errors |
| B | VERY GOOD - above the average standard but with some errors |
| C | GOOD - generally sound work with a number of notable errors |
| D | SATISFACTORY- fair but with significant shortcomings |
| E | SUFFICIENT - performance meets the minimum criteria |
| FX | FAIL - some more work required before the credit can be awarded |
| F | FAIL - considerable further work is required |