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The Program of Lecture Course “Concepts of Modern Natural Sciences”

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Abstract The present paper deals with the author’s program of lecture course "Concept of modern natural sciences". The program is intended for teaching the students of higher educational institutions of humanitarian, economic and art profile. In this line, the course structure, duration of different types of lessons, the main topics of lectures and seminars are discussed.

Keywords: *modern natural sciences, scientific picture of the world*

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1. Introduction

"The concept of modern natural sciences" (CMS) is a principally new general education subject belonging to mathematical and natural-science disciplines. It is aimed at the increase of the common cultural status through acquaintance with natural-science culture and the achievement of high professional level. The CMS discipline should be taught at first two courses in parallel with the studying of the main sections of the higher mathematics and informatics. Knowledge and abilities acquired by the students after studying this discipline can be used for the studying of specialization disciplines.

It is known that application of “Concept of modern natural science” in the training process is a first example in world practice of higher education when the learning discipline is based on the most general, conceptual ideas of modern natural sciences. Taking into account novelty of the subject, absence of sufficient number of professors experienced in this discipline by the time when “Concept of modern natural science” was introduced into the training process (1993) and a number of problems of methodical character, it is easy to imagine the volume of work which has been performed so far at federal and regional levels. Therefore, one can state that “Concept of modern natural science” became today the indispensable discipline of a cycle of mathematical and natural-science disciplines included in teaching plans of many specialties of economic, humanitarian and art profile. The authors of this article took the most active part in the solution of specific problems related to learning and teaching aspects of “Concept of modern natural science”.

The basic moment was the choice of textbooks which could be used for development of the corresponding lecture course. As it was already mentioned above, “Concept of modern natural science” was not methodically supported both on federal and regional (including high school) levels by the time when this discipline was introduced in higher education. Consequently, it generated a need for writing and publishing of the relevant learning and teaching literature. Over the last decade a series of publications related to “Concept of modern natural science” appeared. Among them are not less than thirty monographs which have received a certain popularity in the Russian Federation, and which therefore are used in training process.

The analysis of teaching literature related to “Concept of modern natural science” allows us to conclude that authors of manuals and textbooks have no common opinion about the basic moments of the discipline, in particular, about meaning of the word "natural sciences". For example, some authors (T.Ya. Dubnishcheva [1], Yu.I. Zhigalov [2], L.T. Pashkov [3], S.I. Samygin [4]) assume that the natural sciences are a set of sciences about the nature. In the explanatory dictionary of Russian language the natural sciences are defined as follows: "Natural sciences are a set of sciences about the nature". The definition given in the textbook by A.N. Babushkin is close to this: "Natural sciences in modern understanding are a set of sciences about the nature (natural sciences) taken in their interrelation" [5]. There are also other opinions. For example, D.I. Gryadovoy defines natural sciences as a system of knowledge and the activity aimed at the study of the Nature, a part of life obeying the laws which are not created by humans; this is a system of sciences about the nature [6]. The definition given by A.A. Gorelov is slightly different: "Natural sciences are an area of science which studies the world as a whole, in its natural state, irrespective of the humans. This is an area of science is based on reproduced empirical verification of hypotheses and formulation of theories or empirical

postulates which describe natural phenomena" [7]. A.D. Sukhanov and O.N. Golubev understand natural sciences as an independent integral science about the nature, which is not reduced to the sum of individual natural sciences. "The natural science is a field of knowledge about the nature. It investigates the transdisciplinary relations between natural sciences" [8]. C.B. Shatalov considers modern natural sciences as the new scientific direction which has been originated in the course of integration of knowledge related to all sciences about the Nature [9]. In this regard, now the natural sciences are often interpreted not as a sum of individual disciplines, but as a common science about the Nature, a system-forming factor of all modern culture. In particular, E.F. Solopov defines natural sciences as the integral and important part of human spiritual culture [10].

The above opinions concerning the meaning of the term "modern natural sciences" testify to the existence of a problem of adequate textbooks. However, the some “failure to tell all”, which takes place among the authors of textbooks related to “Concept of modern natural science”, is not limited by interpretations of this term. One can make also critical remarks of more general character. Thus, one should evaluate the published textbooks to find the best examples of training literature taking into account the experience of teaching the “Concept of modern natural science” discipline. Obviously, the availability of various manuals and textbooks hinders the selection of their optimum number that is important for the teacher. It is even more important to make training literature useful in terms of contents and available for students.

Developing the lecture course, we hope that it is not disintegrated into separate fragments, but will demonstrate a conceptual integrity of natural sciences. In this line it is pertinent to note that according to the opinion of Professor F.K. Schmidt, the editor of our textbook [11], the authors of “Concept of modern natural science” managed to present key ideas of modern natural sciences in comprehensible for students-humanitarians form. He also notes that the book is well organized from the pedagogical point of view also. Clarity of presentation, a large number of relevant illustrations allows one to consider this book as one of the most successful publications in this topic. We can also add that our textbook [11] was highly appreciated by the pedagogical community and received many warm comments from the colleagues working in different universities of Russia.

It is assumed that the proposed program would comprise the studying of CMS discipline (102 hours) by the students of humanitarian, economic and art profile (bachelor degree). A schedule of lessons is the following: 34 hours – lectures, 17 hours – seminars, practical training, 51 – independent work of students. Such distribution of hours relative to lessons is based on our (more than ten years) experience of CMS teaching. Independent work of students has to include the following issues:

- unaided studying of topics proposed by teacher;
- writing the note.

In the course of unaided studying the appropriate sections of the discipline the student should make the précis of the material read. Special question are used to control the results of unaided studying. A student should answer these questions which are formulated by the teacher.

The size of the note is 12 - 15 computer pages. The paper structure is as follows: the title page, introduction, main part, conclusion, references. In introduction, the student should briefly (approximately one page) formulate the topic of the paper. In the main part, which may consist of some paragraphs, this topic is discussed. At last, the conclusion (approximately, 0,5 - 1 page) comprises the summary of the literature analysis literature. The student has to promote the paper.

In each specific higher education institution, the proposed Program can be complemented with a material, the studying of which requires more than 102 hours (see above). Naturally, the topic of the program is defined by teachers of this higher education institution taking into account, in particular, the professional orientation of students. Possible sections of additional lessons are given below.

In the development of this program, we faced the following very important question "What specific material should be included in the program?" Beginning approximately from the seventeenth century, the volume of scientific activity doubles each 10 - 15 years (growth of discoveries, scientific information, number of researchers, etc.). Taking into consideration the fact that the huge scientific material has been accumulated by the moment, and the duration of students training is limited, one should make a choice. Here one should remind that the concept is a system of opinions, principles; it is the main viewpoint and leading idea. In other words, the concept is something generalizing and, at the same time, basic. It is a common knowledge that natural sciences were based and are based on physics and its laws. And it is quite natural. Physics deals with the simple and, at the same time, most general properties of the material world. This fact constitutes a basis of the proposed offered Program where the fundamental principles of physics (ideas, laws, general conclusions) are included to. According to the opinion of the authors of this Program, the studying of the above principles will allow the students of humanitarian, economic and art specialties of higher education institutions to comprehend the integrity of the world. In view of the fact the Nature is much more diverse that physics itself, the material of general character related to chemistry, biology and ecology is also included in the Program. The author's program of “The concept of modern natural sciences” discipline should be considered as a mean of overcoming the cognitive barriers (difficulties) related to the third component of a pedagogical triad «how to learn, what to learn, how to study» [12].

2. Content of the Discipline

2.1. History of Natural Sciences [11]

1. Galileo Galilei, Isaac Newton – founders of natural sciences.
2. Outstanding discoveries of the nineteenth century in the field of natural sciences.
3. Revolution in physics in the first third of the twentieth century.
4. The Russian and Soviet scientists – Nobel Prize winners in the field of natural sciences.

2.2. Physical Concepts Used for Description of Nature [11,13]

2.2.1. Fundamental Principles of Microworld Physics

Fundamental principles of classical mechanics. Characteristics of movement. Dynamics. Rotating motion. Fundamental forces of the Nature. Gravitation. Macroworld forces.

Conservation laws. Motion integrals. Work and energy. Conservative forces. Laws of conservation of energy, impulse and impulse moment.

Fundamental principles of relativistic mechanics. Galileo relativity principle. Einstein's postulates. Lorentz transformation laws. Consequences from Lorentz transformations. Mass-energy equivalence.

Thermodynamics. Ideal gas state. Pressure and hydrostatics. Energy distribution. Maxwell and Boltzmann distribution. First law of thermodynamics. Second law of thermodynamics. Entropy. Refrigerators and thermal pumps. Thermal pollution of environment. Time arrow and causality.

Electromagnetic interactions. Electrostatics. Electric current. Magnetic field.

Fundamental principles of optical phenomena physics. Wave-Corpuscle dualism. Wave processes. Wave optics. Lasers. Photoeffect.

2.2.2. Fundamental Principles of Micro- and Megaworld Physics

Quantum mechanics. Wave packages. De Broglie equation. Schrödinger indeterminacy principle. Limitation of mechanical determinism. Physical sense of wave function. Schrödinger equation. Particle in rectangular potential hole.

Atomic physics. Quantization of physical quantities. Pauli exclusion principle. Multi-electron atoms. Mendeleyev periodic system. X-ray radiation.

Nuclear physics. Structure and characteristics of atomic nucleus. The fundamental forces between nucleons. Structure of heavy-nuclei. Mass defect. Alpha, beta and gamma decay. Nuclear fission. Nuclear fusion. Notions on nuclear engineering.

Astrophysics. Main sequence stars. Source of stars power. Death of star. Black holes. White dwarfs. Neutron stars.

Classes of elementary particles. Weak interaction. Photons, leptons, hadrons. Quarks. Parity Parity violation. Antimatter. Report on conservation laws.

2.3. Chemical and Biological Description of Nature [11,13]

1. Types of chemical bonds. Ionic bonding. Stability of ionic compounds. Covalent bonding. Molecular orbitals. Hybrid atomic orbitals. Delocalized orbitals. Coordination bonding. Metal bonding.

2. Condensed media. The nature intermolecular interactions. The theory of free electrons in metals. Zone theory of solids. Semiconductors. Phases and phase transitions. Superfluidity.

3. Main generalizations of biological sciences. Live organisms obey to laws of physics and chemistry. Cellular theory. Biogenesis. Living cells as energy converters. Gene theory. DNA – the main carrier of genetic information. Metabolism processes with participation of enzymes.

4. Evolution of living systems. Theory of organic world evolution. Relationship between organism and environment.

5. Gene engineering. Fundamental difference of genetic engineering from classical selection. How to obtain DNA recombinant molecules? The most impressive practical achievements.

2.4. Biosphere and Civilization [11]

1. The international cooperation on environmental problems. Activities of the Rome club aimed at understanding the reasons of ecological crisis. UN and environmental protection. The declaration of UN conference in Rio de Janeiro on environmental protection and development.

2. Problem of sustainable development. Geological peculiarities of modern ecological crisis. Ways and results of technogenic effect on the upper layers of lithosphere. Anthropocentrism and biocentrism. Main aspects of the sustainable development concept: social, ecological, economic.

2.5. Comments to the Program Contents

We have already mentioned above that the introduction of CMS in educational process is a first example in world practice of the higher education when the studied discipline is based on most general, conceptual ideas of modern natural sciences. Taking into account novelty of the subject, the absence of sufficient number of the trained teachers in higher education institutions, a series of methodical problems, it is easy to imagine what volume of work has been done by the moment at both federal and regional levels. As a result, today one can state that CMS truly became indispensable subject of mathematical and natural-science disciplines which constitute training calendar of many specialties of economic, humanitarian and art profile. Authors of this work had to take active part in the solution of specific tasks related to creation of educational and methodical material of CMS.

The offered author's Program assumes that the CMS course will start from the discussion a problem related to interrelation of two cultures: humanitarian and natural-science. This discussion is based on remarkable lecture of the known writer and scientist C. Snow "Two cultures and scientific revolution". The lecture was delivered in May, 1959 at the Cambridge University (England) and caused long and fierce debate among very different layers of the population in many countries of the world. The first section of the course includes also the material relating to history of natural sciences. It is well known that the core of natural sciences is physics and its laws. Therefore, it is rational that the authors of the offered course will cover only the moment of physics creation, which was originated the science originates by Galileo Galilei, one of founders of exact natural sciences. Besides, this section of the Program contains a short review of the outstanding discoveries made in the nineteenth century in the field of natural sciences, as well as the description of revolution in physics which has happened in the first third of the twentieth century. As for the other historical aspects is

concerned, the Program includes them, when the specific aspects of training material are discussed.

Accounting for a limited number of academic hours which are usually used in higher education institutions of Russia for studying the "Concept", the program discussed here includes a brief description of the activity of only Russian and Soviet scientists, Nobel Prize Winners in the field of natural-science disciplines. Though it is a common knowledge that the researches of other countries have made a big contribution to physics, chemistry, biology. Therefore one can consider that our version of the Program allows adapting its first section to lesson plans used for teaching the students in specific universities of different countries.

The second section of the Program covers the main physical concepts of the Nature description. It begins with paragraph 2.2.1. which deals with the basic postulates of micro world physics. Here model representation of macroobjects and their states; movement relativity; fundamental laws of micro world dynamics, and conservations laws are discussed. The real objects are considered as mass points or systems of mass points regardless of internal state of these objects. In the same paragraph, the phenomena which are defined by interaction and internal movement of body particles are disclosed. We mean here the investigations of characteristics of chaotic thermal movement of molecules means; two fundamental beginnings of thermodynamics (the first and the second); Maxwell and Boltzmann distributions; transfer phenomena; principle of entropy increase; thermal environmental pollution; time arrows and causality of physical processes.

The first paragraph of the second section of the Program includes also a material related to electromagnetic interaction, the fundamental reason of macroobjects continuality. Electric and magnetic fields, their characteristics, laws of electricity and magnetism laws are considered. In addition, basic ideas of physics of optical phenomena, which are indispensable prerequisites of material world existence, are discussed. The dual nature of light, fundamental laws of light distribution, and quantum nature of irradiation are reviewed.

Apart from conceptual provisions of macroworld where Homo sapiens lives, the Program intends to study two other components of the material world, i.e. micro world and mega world. In this connection, we have included paragraph 2.2.2. which deals with Louis de Broglie hypothesis; Heisenberg uncertainty relation; limitations of mechanical determinism; peculiarities micro particles behavior laws. Besides, characteristics of atomic nuclei, nature of nuclear forces, radioactivity phenomenon, reactions with participation of nuclei; nuclear fusion in stars and evolution of the latter are supposed to be considered. Also, classification of elementary particles and problem "grand unification" will be discussed.

The third paragraph of the second section of the Program (2.3) covers chemical and biological description of the Nature. It begins with the description of existing ideas about physical nature of the chemical bonding. In this line, the concepts of ionic, covalent, coordination and metal bonding; molecular, hybrid, delocalized orbitals will be considered. The second part of the section is devoted to the topic, which can be expressed in a one word: "Life". “Science about life" is known to be biology. Therefore this material should correspond to modern level of biological sciences development. The relevant discussion is based on the following major provisions: 1) Living organisms obey the laws of physics and chemistry. 2) All living organisms consist of cells and of products of their activity. 3) All living matter originates only from living matter. 4) Living cells represent energy converters. 5) Evolutionism is one of the main concepts of biology. 6) The gene theory constitutes the basis of generation memory. 7) All living organisms, populating a certain area, are in close relationship with each other and with environment.

The latter provision has been described in detail in the fourth paragraph of the second section of the Program (biosphere and civilization), which is devoted to global problems of modern ecology. The modern mankind exists at the turn of millennia, and this fact prompts people to pay much attention to their future and to better understanding of their past. The problem of interrelation between society and nature became one of the major global problems which agitate people. It becomes apparent that further development of scientific and technical progress should be accompanied by radical transformations of social character, without which the contradiction between society and nature will reach the antagonism menacing to the life on our planet. Thus, now history of mankind has a period when society should correlate accurately its activity with resources of the nature. Fourth section of the Program deals with the reasons which are responsible for the situations when, according to Jacques-Yves Cousteau expression, man frightens the Nature. Besides, peculiarities of modern ecological crisis; technogenic effect on environment; problem of sustainable development are discussed.

Here we should make the following clarification concerning the CMS course which, in our opinion, will render this course quite reasonable character. Really, currently the improvement of training process in universities is associated with realization of novel approach to formation of natural-science thinking on the basis of multi-disciplinary ideas. Such ideas have to constitute the basis of CME. From here follows the obvious problem of methodical character: "What specific material should use the teacher in the course of CMS teaching? And would not this discipline be reduced to simple statements of separate facts taken from specific sections of physics, chemistry, biology, ecology?" Generally speaking, this is a rhetorical question. Really, any worldview, including natural-science one, can be made only on the basis of the corresponding facts related, in particular, to natural sciences. Consequently, the teacher should select these facts and to teach the student in the relevant (methodical) way, while the student should study these facts in order to form a necessary worldview. Thus, need for using the specific material is obvious. As for the reduction of CMS data, for example to physics, this problem, in our opinion, does not exist. From methodical viewpoint, physics is well developed discipline with century traditions of teaching. The teaching of CMS should be based on other methodical principles, the core of which can constitute conceptual ideas.

In the connection with the above clarification, it is pertinent to give the following example here. Traditional

description (physics course) of the nature of contact forces (reaction forces), including friction ones, involves the detailed discussion (at both qualitative and quantitative levels) of their origination. But it is possible to represent this material from other viewpoint: emphasizing that the mentioned interactions belong to macroworld forces. In this case their detailed description is not necessary. One should only state that these forces exist in nature and their manifestation should be shown at such level that the student can form distinct ideas about those forces of nature which are predominant at the macroworld level. Certainly, representation of the factual material in CMS is not a trivial task. The teacher should have the corresponding methodical approaches. In this regard, the informative part of lectures is of crucial importance from the methodical point of view. All lectures prepared by us include the core material, fundamental ideas of the studied section of the discipline, laws of natural sciences. In other words, the lectures have a character of review. Of course, it is an element of necessity: the limited number of academic hours makes us to “compress” lecture material. But such an approach, when the most important (in semantic and structural sense) training material is taught in lectures, creates the conditions for the formation of real panorama of modern natural sciences in student’s consciousness. At the same time, the above-mentioned fragmentary representation of lecture material creates the prerequisites their "second-guessing" the student himself that, in its turn, make the training process quite productive.

We have already mentioned in the introduction that the main goal of CMS is the increase of general cultural level status through acquaintance with natural-science, achievement of high level of professionalism via fundamentalization of natural-science education. In this line, the main objective of CMS studying can be formulated. This is the formation of ideas about natural-science picture of the world as global model of the nature reflecting integrity and variety of the natural world. Therefore, an essential part of CMS course (together with studying of theoretical material) includes practical training (seminars). They are aimed not only at activization of the material studied, but also at stimulation of independent speculations about nature. As a rule, in real conditions practical trainings take eight – nine academic hours. That is why, reaching the optimum variants of seminars performance and formulation of their topics are of major importance. In our opinion, the topics should have integral character. In other words, each of the planned seminar is performed in such a way that its topic would help the student to create the generalized views on nature. Finally, it should promote to the formation of uniform natural-science picture of the world in their consciousness of students.

3. Contents of Extra Lessons

3.1. Physics of Open Systems [14,15]

Properties of the self-organized structures. Dynamic systems. Determinated chaos. Ressler chaotic attractor. Cantor set. Fractals. Feigenbaum scenario.

3.2. New Objects of Nuclear Physics [14,16]

Exotic atoms. Multicharged ions. Rydberg atom. Excimer molecules. Clusters. Fullerenes. Endohedral compounds. Carbon nanotubes.

3.3. Quantum Information [14]

The superposition, entangled states. Quantum computers. Quantum cryptography. Quantum teleportation.

3.4. Nuclear Physics [14,16]

Quarks in nuclei. Power properties of nuclei. Nuclei remote from stability areas. Proton and two-proton radioactivity. Cluster radioactivity. Superdense nuclear matter.

3.5. Structure and Dynamics of Molecules [14,15]

Modern physical methods for the research of molecular structure: nuclear magnetic resonance, electronic paramagnetic resonance. Mathematical models of molecules structure and dynamics theory.

3.6. Nonlinear Optics [14,16]

Multiphoton processes. Bose – Einstein condensation. Non-stationary effects. Solitons.

3.7. Origin of Life and Thinking from Viewpoint of Modern Physic [14]

Dynamic properties of simple proteins. Problem of life origin. Problem of biological development rate. Information. Problem of thinking origin.

3.8. Our Star - the Sun [11]

Solar structure. Solar activity. Sun and Earth. Coronal holes. Land methods of solar research.

3.9. Organic Molecules in Action [11]

Giant molecules. Mercy molecules. Powerful molecules. Steroid family. Molecules of health. Molecules of sensual perception.

3.10. Comments to Extra Lessons Contents

The development of modern science is marked by avalanche-like growth of information. Having originated in the ancient times due to the requirements of public practice, the science became the productive force and the major social institute having considerable effect on all spheres of society and culture as a whole. The consequence of this rapid growth of information includes ever-increasing gap between the level of knowledge reached by science and level of training in the universities.

Ever-increasing integration of scientific research represents another distinctive feature of modern natural sciences (along with growth of information volume). Such tendency makes more and more conditional the division of natural sciences into strictly specific disciplines. Though the predominating role of physics, which studies the simplest and at the same time the most general properties of a material world, remains intact. Besides, specifics of research topics of other branches of natural sciences also do not change.

Two features specified (rapid growth of scientific information and ever-increasing integration of various branches of natural sciences) lead to the problems of methodological character which need to be solved in the course of the publication of educational materials. Urgency of the problem is strengthened by fact that the emphasis is very often placed on how to learn. However, the problem is other: "to what to teach".

All the above has prompted the authors [14,15,16] to prepare and publish a series of monographs under the general title "Physics at the Turn of the Millennia", where major achievement of physics for the last fifty years have been covered. The first monograph consists of three sections. In the first section, the scientific advancements of in the field of the self-organized and ordered systems are discussed [14]. In particular, it discloses the main postulates of new interdisciplinary scientific direction, physics of open systems, which has been originated due to the works of outstanding researchers of the XIX century. Among them are physicist L. Boltzmann, mathematicians A. Poincare and A. Lyapunov, biologist Ch. Darvin. The second section of the first monographs deals with the novel objects of atomic and nuclear physics as well as with new direction of physics – quantum information, which has been originated owing to development of the ideas of quantum mechanics which until now remained unclaimed. Finally, the third section of the first book is dedicated to new achievements in the field of organic world. For instance, some fundamental questions related to the problem of life and thinking origin are discussed. Trying to answer these questions, researchers rely on the progress of modern physics.

The second monograph of this series covers the achievements of physics condensed systems [15]. The nonlinear-optical and electric phenomena in materials, which are characterized by condensed state of matter, are described. The main characteristics of a number of new analytical methods for the research of condensed states are discussed. The third monograph (textbook) of the series "Physics at Turn of the Millennia" is devoted to physical regularities of material world having nano - and microsizes. Nowadays, we witness that nanosciences are gathering force. As a consequence, the scope of application of scientific achievements in various spheres of human activity significantly extends. Therefore, it is obvious that the edition of the corresponding educational literature, first of all, for the higher school becomes an urgent challenge. The publications, including original research papers and reviews, related to various aspects of micro and nanoworld physics are numerous. They are indented mainly for experts. As far as the educational literature dealing with the aforementioned fields of knowledge, it is practically absent. The textbook fill this gap to a certain degree [16].

4. Conclusions

The need of acquaintance of humanitarian, social and economic specialty students with the conceptual base of modern natural sciences is the essential requirement of time and is connected with transition to qualitatively new level of wide profile specialists training. Today such an expert should be not only the professional in his own area, but also, first of all, the leader possessing a proactive approach to life and capable of forming this approach at other persons. In turn, life philosophy depend on the general cultural level of person, which is formed in the course of education. One of indicators of such general cultural level is the scientific view of the world, knowledge of modern natural-science picture of the world, the critical relation to occultism and pseudo-science. Thus, one of the main goals of "The concept of modern natural sciences" discipline is increase of general cultural and educational level of bachelors of the corresponding specialties.

Participating in organization and management of the production based on advanced technologies, in formation of the public relations, in regulation of financial flows, the graduates of humanitarian and economic universities need a certain level of natural-science knowledge allowing to control directly innovation process, quickly and correctly to estimate different suggestions on the improvement of advanced technologies, and to forecast breakthrough of scientific and technical progress. Therefore, another purpose of CMS discipline is creation of prerequisites for the formation of modern innovative and technological thinking of economists.

In many cases, the methodology applied in adjacent and sometimes remote enough sciences essentially help in professional activity of an expert. That is why another purpose of CMS discipline is improvement of research methods in humanitarian and social-economic fields.

References

[1] T.Ya. Dubnishchev. Concept of modern natural science. - M: IVC "Marketing", Novosibirsk: “YuKEA”, 2000. -832 p.

[2] Yu.I. Zhigalov. Concept of modern natural science. - M: "Gelios ARV, 2002. -271 p.

[3] L.T. Pashkov. Natural sciences. Manual. - M: MEI, 2001. - 128 p.

[4] S.I. Samygin. Concept of modern natural science. A textbook. - Rostov-na-Dony: "Phoenix", 2001. -576 p.

[5] A.N. Babushkin. Modern concepts of natural sciences. - SPb.: "Lan", 2001. -203 p.

[6] D.I. Gryadovoy. Concepts of modern natural sciences: The structured textbook. - M: YuNITI, 2003. -239.

[7] A.A. Gorelov. Concepts of modern natural sciences: A textbook for universities. - M: VLADOS center, 2003. -512 p.

[8] A.D. Sukhanov, O.N. Golubev. Concepts of modern natural sciences. Textbook for humanitarian students of universities. - M.: "Agar", 2000. -452 p.

[9] S.V. Shatalov. Concepts of modern natural sciences. Practical work. - Rostov-na- Donu: "Phoenix", 2003. -222 p.

[10] E.F. Solopov. Concepts of modern natural sciences: A texbiook for universities. - M: VLADOS center, 2001. -232 p.

[11] V.K.Voronov, M.V. Grechneva, R.Z. Sagdeev. The foundations of modern natural science: a manual for universities. - 2nd Ed.., - M.: Vyshaya Shkola, 1999. -247 p.

[12] V.K.Voronov, L.F.Geraschenro Cognitive Barriers in Training the Students of Higher Education Institutions, Methodology for their Elucidation and Overcoming. I.J. Modern Education and Computer Science, vol.1, No 2, 2013.

[13] V.K.Voronov. Concepts of modern natural science: Textbook. – Irkutsk: IrGTU, 2006. -232 p.

[14] V.K.Voronov, A.V. Podoplelov. Modern physics: Textbook. - M: KomKniga, 2005. -512 p.

[15] V.K.Voronov, A.V. Podoplelov. Modern physics: Condensed state: Textbook. - M: LKI, 2008. -336 p.

[16] V.K.Voronov, A.V. Podoplelov, R.Z. Sagdeev. Physical foundations of nanotechnologies: a manual. – LIBROKOM, 2011. -536 p.