CONTENT

CULTUROLOGY

PEDAGOGICAL SCIENCES

PHILOLOGICAL SCIENCES

FEATURES OF TEACHING MATHEMATICS OF FUTURE BACHELORS OF COMPUTER SCIENCES IN THE AGRICULTURAL UNIVERSITY

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Abstract

The article considers the problem of mathematical training of bachelors of computer sciences in higher agricultural educational institutions. Based on research in the psychological, pedagogical and methodological literature, the question of the importance of mathematics for future specialists in information technology and the peculiarities of the study of higher mathematics by students is analyzed. The need to modernize the content and methods of teaching mathematical disciplines, in particular higher mathematics, in higher agricultural educational institutions has been confirmed. The methodical system of teaching mathematical disciplines and ways of its introduction into the educational process are offered.

Keywords: mathematical disciplines; higher mathematics, agricultural university; information and communication technologies; the content of teaching mathematics; methods of teaching mathematics.

Introduction. In the context of globalization, informatization and digitalization of society, the system of higher education in Ukraine faces new requirements for the training of IT specialists, in particular, bachelors of computer science. The information technology industry has already changed the world and continues to play a key role in its further rapid development. Thus, professionals in this field are among the most in demand in the labor market of developed countries. However, at the present stage it is a question of training such a specialist who is able to find the necessary information at the right time, analyze it, correlate the obtained information with the tasks to be solved, and on this basis develop adequate ways to solve the problem. As practice shows, the requirements for the level of mathematical training of computer scientists are growing over time. And now it is impossible to train such specialists without thorough mathematical training.

The importance of mathematical disciplines, which are a system-forming element of educational and professional activities of students of the Agricultural University, in particular, the specialty "Computer Science" is growing.

The effective activity of specialists in the modern information space involves high-quality mathematical training, which is characterized not only by the accumulation of a certain amount of knowledge, but also the development of logical thinking, spatial representations; formation of skills to establish causal relationships, substantiate statements, model situations, affects the development of personal and professionally significant qualities of future professionals, allowing them to self-realize in the field of future professional activity. The driving force of the development of mathematical training of students, agreeing with G. Dutka, we see in the dual principle of fundamentalization and professionalization of education, which reveals in the education system contradictions between needs and available means of meeting them, which can give science and practice due to the discovery of new facts and connections, and the emergence of new requests for practice that require the development of new theoretical knowledge. Fundamentalization of mathematics education makes it possible to consider it in conjunction with the training of future professionals. It is a means of transition of a certain set of mathematical knowledge into a new quality - professional and mathematical knowledge, which includes as an important component of intellectual activity, responsibility, independent thinking and principle [1, p. 241].

We agree with the opinion of Doctor of Physical and Mathematical Sciences L. Kudryavtsev that university graduates should be able to build mathematical models, set mathematical problems, choose the optimal method and algorithm for solving the problem, use numerical methods to solve the problem. using modern computers, to apply rational mathematical research methods, on the basis of the analysis to make practical conclusions [4].

Analysis of recent research and publications. Analysis of scientific and pedagogical literature revealed a wide range of work aimed at studying the state of mathematical education of students of higher technical (K. Vlasenko, G. Kashkanova, V. Klochko, T. Krylova, V. Petruk, I. Khomyuk), economic (N. Vanzha, G. Dutka, L. Gusak, K. Rumyantseva, L. Nichugovskaya, G. Pastushok , Y. Tkach, O. Fomkina), agricultural (N. Borozenets, I. Gorda, O. Levchuk, Y. Ovsienko, G. Silenok) educational institutions. At the same time, the state of mathematical training of bachelor's students in computer science of agricultural higher educational institutions was practically not considered.

The study of publications on the problem of mathematical training at the Agricultural University and our own teaching experience revealed a contradiction between the objective need to implement and apply mathematical methods in the teaching of professional disciplines and insufficient development of methods for implementing these methods in the educational environment. Graduation departments require the expansion of some sections of classical mathematics and the introduction of new ones, and departments of mathematical disciplines are not able to provide a satisfactory level of knowledge and skills of students, because, first, study groups include students who do not have sufficient cognitive development (attention, memory, thinking), so unable to master the material of the disciplines, secondly, reduces the amount of classroom workload, which is not desirable to make reductions in

the first year. There is a need to restructure and rethink the goals, content, methods and organizational forms of teaching mathematics at the Agricultural University, which will adapt future computer scientists to modern requirements of the information society and allow them to use the mathematical apparatus in their future careers.

Thus, the purpose of our study is to analyze, theoretically substantiate and develop a methodological system for teaching mathematics to students of agricultural universities in the specialty "Computer Science".

The history of the development of mathematical science is about three millennia and can be divided into several periods. The first period is the formation and development of the concept of number, solving the simplest practical problems in geometry. The second period is associated with the emergence of Euclidean geometry and the substantiation of the method of proving mathematical judgments using logical inferences. The next stage begins with the development of differential and integral calculus. The last period is also accompanied by the emergence and spread of concepts and methods of set theory and mathematical logic, on the basis of which all modern mathematics is built. The entry of society into the information phase of its development at the beginning of the XXI opened new opportunities in the application of information and communication technologies. In turn, the development of these technologies stimulates the emergence of new and improvement of "old" classical sections of mathematics. The next stage of its development begins.

For many centuries, mathematics has been and is an integral part of the system of higher and general education in all countries of the world. This is because the role of mathematics in shaping personality is special. Its developing, educational potential is huge, because mathematics shapes logic - a universal element of thinking. Students carry out mental activity through mathematics, as it is characterized by: the ability to correctly analyze a process or phenomenon and draw conclusions through logical reasoning; the ability to distinguish the proven from the unproven, the known from the unknown; ability to classify, generalize, express assumptions, refute them or confirm a system of logical reasoning, use analogies.

The second important feature of mathematics is its language of symbols as a specific means of communication. Literate mathematical language testifies to organized and clear thinking and mastering it, understanding the content, logical connections and influences the development of ordinary speech, thus making a significant contribution to the formation and development of analytical thinking.

It is necessary to pay attention to one more extremely important feature of mathematics: its influence on development of volitional qualities of the person: persistence, stubbornness, stability, purposefulness, confidence, creativity, character formation, moral traits. To solve a mathematical problem (not only to find the correct answer, but also the optimal solution) it is necessary to go through a thorny path. In mathematics, the mistake cannot be hidden - there are objective criteria to determine whether the solution is complete and reasonable, and the result is correct. Thus, mathematics contributes to the formation of not only the intellectual sphere, but also the moral traits of the individual.

In addition, mathematical disciplines contain a practical, utilitarian component, which has a completely independent meaning. To navigate in the modern world, everyone must have at least a minimum stock of knowledge and skills of mathematical nature (computational skills, elements of practical geometry, the concept of function and graph, addition and solution of elementary equations, inequalities, systems, proportions, etc.).

Mathematical disciplines at the Agricultural University in the specialty "Computer Science" are usually studied in the first, second, third year of study and are for students one of the most difficult to master the disciplines. The main reason is the abstractness of mathematical theory. Mathematical concepts are more or less successful models of certain real phenomena and processes. Another reason is that a huge amount of theoretical material needs to be studied in a short time. For example, the invention and assimilation of sections of the derivative function and integral has been studied by mankind for several centuries, and students must master these sections in one semester. In addition, mathematical disciplines are full of various ideas and methods, a large number of concepts, so students, including freshmen, are not able to study them in such a short period of time. Due to this, the methodical system of teaching mathematics is forced to intensify its capabilities. Thus, the question of the content, methods and means of improving the quality of mathematical training at the present stage remains quite relevant.

In our opinion, higher mathematics occupies an important place in the system of mathematical training of future specialists-engineers and in the structural-logical scheme of the specialty "Computer Science". The difficulty in constructing mathematics education at the Agricultural University is that higher mathematics in it occupies a dual position. On the one hand, it acts as a special general education discipline, as knowledge of higher mathematics is the foundation for the study of other related and professional disciplines. On the other hand, for most specialties of higher agricultural institutions, higher mathematics is not a profile discipline. Thus, most students are convinced that mathematics at the Agricultural University does not bring them closer, but distances them from acquiring professionally important knowledge, skills and abilities.

We are convinced that in the first lecture during the acquaintance with students the teacher is obliged to reveal the role and importance of mathematics in further educational activities, the relationship of mathematics with other disciplines, the study of which they consider most important for their future profession.

As an example, we analyzed the educational and professional training program for bachelors in the field of knowledge 12 "Information Technology" specialty 122 "Computer Science" 2019. According to this program, the discipline "Higher Mathematics" provides the study of the following disciplines: physics, information technology, probability theory and mathematical statistics, econometrics, discrete mathematics, numerical methods, algorithm theory, object-oriented programming, systems modeling and others.

Thus, in the structural and logical scheme of the educational process, the discipline "Higher Mathematics" is the starting point. It precedes the study of physics, probability theory and mathematical statistics and virtually all related and vocational disciplines.

In particular, the analysis of work programs and educational literature on physics showed that the concepts and methods of linear and vector algebra, mathematical analysis are systematically used in the introduction of many theoretical provisions of the physics course and in solving specific physical problems. The study of the physical foundations of the theory of electric current and electromagnetism is based on the concepts of vector analysis and vector algebra (linear operations on vectors, types of products of vectors, gradient, divergence, flux, etc.). The study of oscillatory motions and waves is based on the knowledge of concepts and methods for solving ordinary second-order differential equations, concepts that are related to partial differential equations. If you analyze the programs of disciplines of professional training, you can also see a number of mathematical concepts used in the study of these disciplines.

Thus, it is obvious that the content of teaching mathematics at the Agricultural University is the basis for studying the disciplines of fundamental and professional training of bachelors in computer science, so the mathematics course should be more dynamic, subject to constant correction, improvement in modern science and technology.

In addition, the problem of the ratio of classical and applied mathematics in agricultural institutions has acquired new aspects.

There are different views on the content of mathematical disciplines in the Agricultural University. We see ways to improve the quality of mathematical training by strengthening the internal logical connection of the discipline on the basis of scientific knowledge. This is due to the fact that in contrast to applied knowledge, fundamental, theoretical aging is slower, the methodological effectiveness of the latter is much higher.

Thus, the value of the methodology of theoretical knowledge is beyond doubt. However, it would not be enough to limit the teaching of mathematical disciplines to a fragmentary illustration of professional problems. There must be a systematic, deeper and multifaceted connection. Based on the above, we have the opposite point of view, which provides for a broader inclusion in the content of mathematical disciplines of an applied nature. This is due to the fact that in the study of such disciplines, students do not acquire the skills to apply mathematical knowledge in further educational and professional activities. In particular, the implementation of interdisciplinary links of fundamental and professional disciplines, the implementation of educational material of professional orientation should not violate the interdisciplinary links of mathematics, the logic of the discipline, turn it into a cycle of separate, unrelated issues.

Thus, mathematical disciplines in agricultural universities must meet the requirements of fundamentality and professional orientation.

An in-depth analysis of the state of mathematical training of students of higher technical educational institutions was presented in the works of T. Krylova [3]. The results of her research and her own practical experience show that the times of "abstract" mathematics courses, designed equally for "pure" mathematicians, applicators and high school teachers, have passed irrevocably. Requirements for mathematical education of a modern specialist, in particular bachelors in the field of "Information Technology" have changed significantly recently. There were courses in special sections of mathematics. However, before studying these sections and applying them in research and practice, the student must understand the basic concepts, ideas and methods of mathematical science. And this cannot be achieved without mastering the classical sections of mathematics.

Unlike the study of mathematics at the mathematical faculties of classical universities, in agrarian higher educational institutions the teaching of mathematics does not aim at the detailed disclosure to students of the sections of mathematics, their logical structure. Mathematics is practically not studied for applied, practical purposes and is not considered as a means to solve professional problems. The main focus is on mastering the general techniques and tools, rather than on the development of skills of strictly logical processes of reasoning and proof. In the first place is the habit of using ready-made answers and various aids without proof.

It is obvious that the course of higher mathematics for bachelors of computer science should be continued by the course of applied mathematics, but not narrowly utilitarian and prescription, but one that contains the necessary theoretical provisions. Applied mathematics is not a simplified version of pure mathematics, the latter is not a higher degree than the former.

Thus, studying the process of teaching mathematics, in particular higher, in agricultural universities, based on the research of scientists, methodologists, we believe that the teaching of mathematics in such educational institutions should be subject to the following goals:

– to report the basic theoretical provisions necessary for the study of related and professional disciplines, to teach the appropriate mathematical apparatus, based on the principles of fundamentality and professional orientation and based on the rationale of the empirical material;

– to develop skills and abilities to solve applied problems: to translate a real situation into mathematical language, to choose the optimal research method, to interpret the research result and to evaluate its accuracy;

– to form skills of bringing the solution of the problem to the final result – the exact correct conclusion, numbers, graphs, using computing tools, reference books, tables;

– combine traditional and information and communication technologies in educational activities;

– to form the ability to use the available scientific and methodological literature, to independently understand the mathematical apparatus used in other disciplines;

– to develop analytical and logical thinking, to educate students in applied mathematical culture, the necessary intuition and erudition in the application of mathematics.

Note that the formation of mathematical knowledge, skills, abilities of students of agricultural higher education institutions must satisfy the following principles:

– the principle of purposefulness (connection of mathematics with the relevant field of study);

– the principle of continuity (study of mathematical methods throughout the period of study and their use in courses of professional disciplines, as well as in writing master's theses);

– the principle of continuity (improvement of mathematical preparation for admission to higher education, during training in it and after its completion);

– the principle of modeling (the formation of mathematical thinking, through which the subject reveals the causal links not only in mathematics but also in professional and other social activities);

– the principle of universality (the introduction of professional-applied component that forms the idea of universality of mathematical formulas and methods);

– the principle of motivation (determination of the content of the course of mathematics, forms and methods of the educational process, providing increased interest of students in the study of mathematics, the introduction of clarity through information and communication technologies);

– the principle of self-study and self-education (development of the student's ability to self-study and self-education during professional activity).

Based on the above, the need to modernize the teaching of mathematics at the Agricultural University is obvious.

In the course of our research, some components of the methodological system of teaching mathematical disciplines at the Agar University of Bachelors of Computer Science were developed and clarified, namely: the definition of principles, methods, tools and conditions of implementation.

The purpose of the methodical system of teaching mathematics:

– organic combination of higher mathematics with disciplines, in the process of teaching which mathematical concepts and methods are used;

– ensuring the level of mathematical knowledge, skills and abilities, which guarantees mastery of the foundation of professional disciplines studied at the Agricultural University;

– formation of ideas about the role and importance of mathematics in the development of intellectual abilities of the individual, the relationship of mathematics with other disciplines of the chosen specialty;

– education of interest in mathematics as the main tool for the analysis of production phenomena and processes, the construction of theoretical models that allow to reflect existing relationships in the professional environment, to predict the behavior of objects and their dynamics.

The components of the methodological system are motivational, semantic, activity and effective. The semantic component includes a system of subject knowledge, including concepts, categories, theories, laws; operations of mental activity, the degree of formation of which provides the ability to conduct analytical reasoning, to make the right inferences, to establish causal links between events, facts, processes. The activity component is characterized by systematic, efficient knowledge; ability to learn mathematical positions. The effective component contains information about the ability to apply the acquired mathematical knowledge in the tasks of other professional disciplines and in future professional activities. The motivational component of the system is determined by the attitude of the individual to the teaching of mathematics, promotes the development of such positive personality traits as self-determination, self-esteem, self-regulation of independent learning activities.

The methodological system of teaching mathematics, like any other, is based on the principles of construction, which are based on the didactic principles of higher education, namely: the optimal combination of fundamentality and professional orientation, science, connection of theory with practice, system and perspective, accessibility, priority of independent learning; productive interaction of teaching aids in independent learning activities. The implementation of the principles of this methodical system of teaching mathematics involves the use of a set of methods that are combined with general didactic methods. Based on research in the scientific and pedagogical literature, we distinguish the following methods: information-receptive; reproductive; methods of problem-based learning.

Forms of education perform an organizational function in educational activities and are a means of continuous management of independent educational activities of students. To ensure the quality of mathematics education, we provide the following forms of educational activities: lectures (lecture-presentation, lecture with planned mistakes, problem lectures, video lecture); practical and laboratory classes, where most of the independent work; individual and group consultations; extracurricular independent learning activities; participation of students in conferences, writing projects. The purpose of lectures is the assimilation of theoretical material by students, the formation of mathematical culture, the development of analytical and logical thinking. The purpose of practical and laboratory classes is to consolidate theoretical knowledge, transfer them to the plane of practical application, the formation of information culture, the development of skills to apply information and communication technologies.

At the present stage, it is impossible to imagine educational activities without the use of modern information and communication technologies. Indeed, the computer has become an integral part of everyone's learning. At the present stage, it is impossible to imagine learning activities without the use of modern information and communication technologies. Indeed, the computer has become an integral part of every student's learning, and the use of such technologies is an integral part of the student's learning process, and the use of such technologies is an integral part of the learning process.

In our study, depending on the tasks we set ourselves, we use computer technology as a tool: information, demonstration, modeling, computing, control.

Information and communication technologies contain educational and methodological support of mathematical disciplines (Fig. 1). For this purpose, an electronic management system of the higher educational institution "Socrates" is used [2]. Demonstration computer technologies provide an opportunity to make a presentation of a part of a lecture material, a speech at a conference; serve as a means of visualization. Modeling computer technologies (GRAN1, MathCAD,) are of great importance for the intellectual development of the individual. With their help the skills of independent research activity are developed, without which the effective work of the future specialist is not possible.

For example, in the preparation of a lecture-visualization, implementing the principle of clarity, the use of the MathCAD system (Fig. 2) not only increases the perception of educational material, but also allows you to get deeper into its essence. Visualized educational

information, being perceived and understood, serves as a good support for practical application [5, p. 82].

Computing computer technologies (MathCAD, MatLab, Excel) allow you to quickly perform calculations, which allows you to spend more time looking for other ways to solve the problem or to analyze the result.
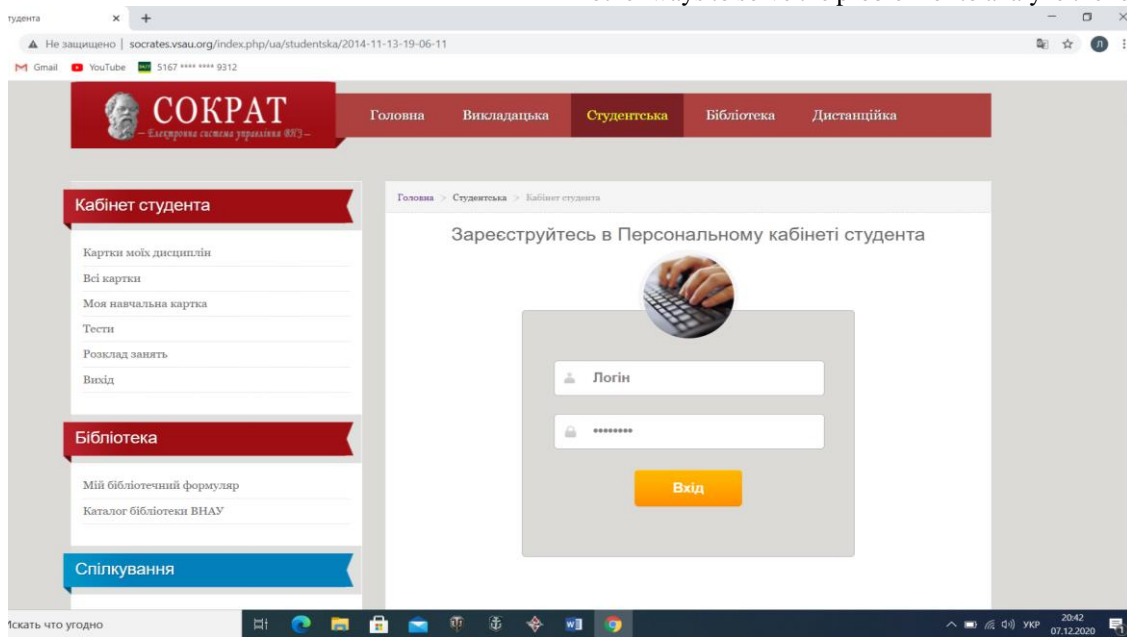

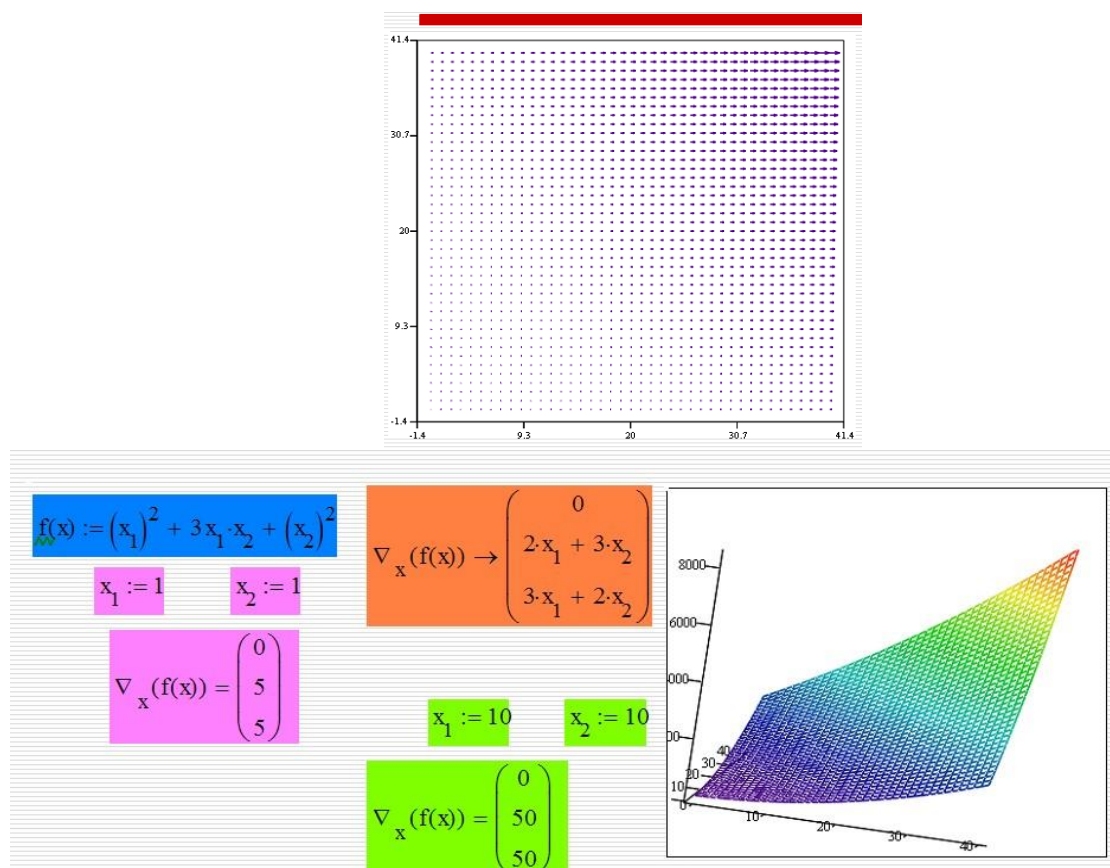*Fig. 1. Appearance of the Socrates system*

Fig. 2. Use the MathCAD system to find gradient function

Controlling computer technology is designed to test knowledge, to determine the level of skills and abilities. Test tasks in academic disciplines are developed according to the "Test Master" program. A successful combination of different types, forms of organization and methods of control is an indicator of the level of the educational process in higher education, proof of pedagogical skills of teachers [6].

It should be noted that only an organic combination of traditional and computer technology contributes to the successful learning activities of students. According to scientific research, when working with a computer, mental capacity is reduced inversely proportional

to the studied amount of educational material, in particular, perception by 6%, memory by 10%; local fatigue of the visual analyzer in the process of only automated learning occurs 2-3 times more intensely.

Teachers of the Department of Mathematics, Physics and Computer Technologies of Vinnytsia National Agrarian University developed the content and detailed the semesters of higher mathematics. Since the course of higher mathematics is the same for almost all specialties, in the first year we propose to study the following sections: "Linear and vector algebra", "Analytical geometry", "Introduction to mathematical analysis", "Differential calculus of one and many variables", "Integration" functions of one variable "," Differential equations ", (in each semester of classroom hours – 90,

of which lectures – 30 hours, practical classes – 28 hours, independent work – 32 hours). In the second year it is offered to study other sections of mathematics which are coordinated with final departments according to a direction of a specialty.

Educational and methodical support of teaching mathematics is an educational and methodical complex of the discipline "Higher Mathematics". Such a complex contains the program and work program of the discipline, lecture notes and presentations, textbooks, guidelines for practical classes and independent work, options for individual tasks and examples of their solution, typical tests, tests, questions for the exam, test tasks (Fig. 3).

Fig. 3. Card of the discipline "Higher Mathematics"

Conclusion. High-quality bachelor's degree in computer science is based primarily on mathematics. On the other hand, attention to improving the quality of mathematical education of students of the Agricultural University in the field of "Information Technology" contributed to the development of mathematical methods and mathematical modeling, which are used in the professional activities of future professionals. It is not possible to teach a person for life, but the teacher must form and develop a culture of thinking, which will allow future professionals to self-learn and self-realize in the modern world of science and technology.

The above provisions of the study do not claim to be the final solution to the problem of mathematics education at the Agricultural University, it is relevant, so it determines the conduct of theoretical and practical research in this area in the future.

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