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METHODOLOGY OF IMPLEMENTING DIGITAL TECHNOLOGIES IN TEACHING THE THEME OF SECOND-ORDER SURFACES

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Abstract: The article reveals the role of using digital technologies, including the Maple program, in mastering geometry. It has been shown that the use of computer technology in teaching geometry is useful for increasing the effectiveness of this lesson; students work through examples and independently make appropriate judgments and conclusions. In particular, when teaching analytical geometry, second-order surfaces and their relative position with planes, the problems of working with examples using the Maple program and showing specific areas on graphs for clarity are highlighted.

Key words: digital technologies program Maple, equation, graphic, function, ellipse, parabola, giperbola.

Introduction. Currently, the development and implementation of effective methods for teaching exact sciences in education, including higher education, is one of the most pressing issues. The use of digital technologies in teaching analytical geometry, which is part of the sciences, is especially useful in solving complex spatial problems for students. The main essence of the proposed methodology is that the main topics that should be taught throughout the course are selected, they are developed based on digital technologies and introduced into the course. It is also known from experience that the place and role of mathematical packages in the educational process are much more significant and of high quality, and their use during the lesson makes it easier to solve complex mathematical problems. The use of mathematical software packages in the educational process ensures the improvement of the fundamentals of mathematical and technical education. This improves students' skills in applying theoretical knowledge in practice. One of mathematical software package is the Maple package and its various versions. Maple is a computer program that performs analytical and numerical calculations, contains more than 2000 commands, and also allows you to solve problems in algebra, geometry, mathematical analysis, differential equations, discrete mathematics, physics, statistics, and mathematical physics problems without programming. One might say that Maple is a large calculator that solves mathematical problems in the areas listed above. Currently, Maple software is being improved and its versions Maple 9.5, and Maple 11 are widely available.

The main part. Today, Maple creates many opportunities for learning geometry for students. In particular, in the process of higher education it is difficult to solve examples and problems related to second-order surfaces and the construction of their graphs, and working with the Maple program greatly facilitates the task for students. Checking the results on the computer and creating graphs of geometric shapes using the program Maple allows students to understand the essence of the problem, easily solve it, and draw a conclusion based on the result obtained.

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Let's consider the method of constructing graphs of second-order surfaces specified by a general equation, as well as their relative position with the plane from the geometry course using the Maple program.

To construct a graph of a second-order surface given a general equation using the Maple program, we need to know the order and commands for plotting in Maple.

Problem 1. Determine the relative position of the sphere with the given equation $x^2 + y^2 + z^2 = 1$, and the plane $2x + 3y - z = 0$:

>with(plots): implicitplot3d([x^2+y^2+z^2=1,2*x+3*y-z=0], x=-1..1, y=-1..1, z=-1..1);

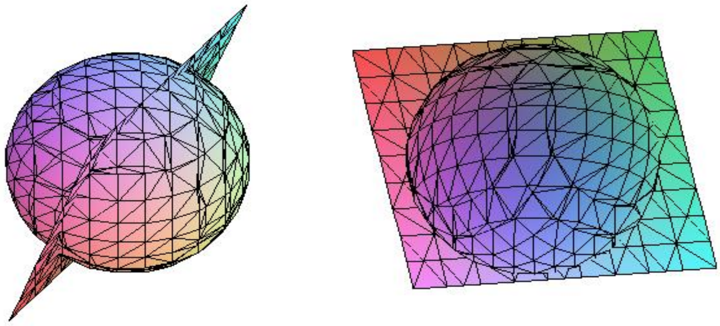
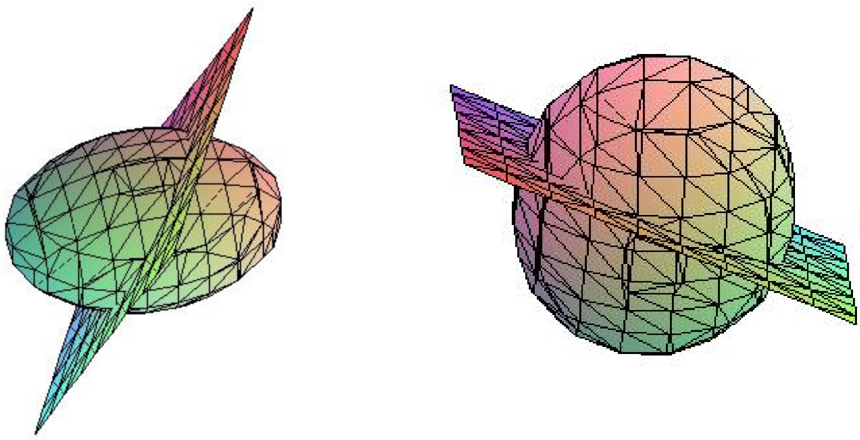


Figure 1. Intersection of a sphere and a plane

Problem 2. Determine the relative position of the ellipsoid $x^2 + 2y^2 + 3z^2 - 1 = 0$ and the plane $2x + y + z = 0$:

>with(plots):
implicitplot3d([x^2+2*y^2+3*z^2=1,2*x+y+z=0], x=-1..1, y=-1..1, z=-1..1);

Figure 1. Intersection of an ellipsoid and a plane



Problem 3. Determine the relative position of the hyperboloid $\frac{x^2}{3} + \frac{y^2}{5} - \frac{z^2}{2} = 1$ and the plane $x + 3y - z = 0$:

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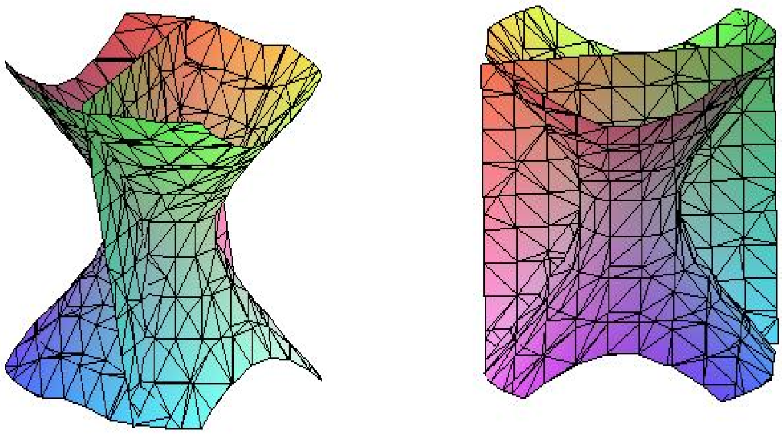
>with(plots):

implicitplot3d([x^2/3+y^2/5-z^2/2=1,x+3*y-z=0], x=-5..5, y=-5..5, z=-4..4);

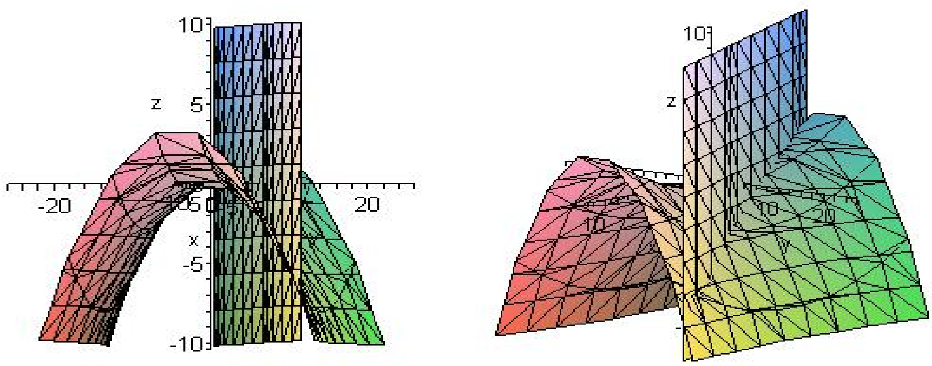
Figure 3. Intersection of a hyperboloid and a plane



Problem 4. Determine the relative position of the hyperbolic paraboloid $\frac{x^2}{5}-\frac{y^2}{4}=6z$ and the plane $x-y+6=0$:

with(plots):implicitplot3d([x^2/5-y^2/4-6*z=0,x-y+6=0], x=-10..10, y=-25..25, z=-10..10);

Figure 4. Intersection of a hyperbolic paraboloid and a plane



Conclusion: So, by using the Maple software package for solving mathematical problems, you can describe not only standard geometric figures, but also complex surfaces defined by various formulas (including a paraboloid, ellipsoid, hyperboloid or hyperbolic paraboloid), and their sections. From the above examples, it can be seen, that when spatial circular figures are mutually positioned, it is necessary to solve their equations together, but in this case, it formed two systems of equations with

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three variables. It is known that such a system of equations has infinitely many solutions. That is, there is no specific solution for them. It can be seen that to show the domain of their solutions, it is necessary to determine the domain of their intersection. In the first example it is a circle, in the second example it is an ellipse, in the third example it is a hyperbola, and in the fourth example it is a curve line. If we can describe the appearance of these shapes in 3D as they move into three-dimensional space, then using a computer it will be possible to express the result from different angles. In this case, students will have the opportunity to learn more deeply about the topic "Surfaces of the second order" in the course of analytical geometry.

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