Checking the Functions Set in the form of Undisclosedly

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Abstract: This paper introduces the concepts of the inverse function and focuses on one of the methods of constructing the equations of the points of intersection and asymptotes of the graph of the inverse function with the coordinate axes.

Keywords: function, disclosure function, implicit function, curve, abscissa axis, ordinate axis, asymptote, oblique asymptote, vertical asymptote, horizontal asymptote

As you know, in recent years in our republic, great importance is attached to the field of education. During this period, a new law "On Education" was adopted in our republic, which provides for the training of competitive specialists that meet international standards.

Among the types of education listed in the law, higher education is considered an important stage, since at this stage qualified specialists are trained in the field of science, technology, economics, medicine, etc. The science of mathematics occupies a special place in the training of such specialists, because today any specialist in his work often resorts to mathematics and mathematical methods. This indicates the need for further development of research in mathematics and mathematical sciences, as well as further improvement of their teaching. The relevance of this issue was reflected in the Decree of the President of the Republic of Uzbekistan No. PP-4387 "On state support for the further development of mathematical education and sciences, as well as the radical improvement of the activities of the Institute of Mathematics named after V.I. Romanovsky of the Academy of Sciences of the Republic of Uzbekistan "dated July 9, 2019.

It is known that the main (essential) topic of the subject of mathematical analysis, which is considered a mathematical discipline, is the concept of a function. Function is also one of the leading themes of the mathematics course taught in mainstream schools and higher education institutions. It is considered one of the basic mathematical concepts that express the relationship between variables.

The more fundamental the concept of number in the study of quantitative relations in the real world, the more fundamental is the concept of a function in mathematics and its applications associated with the study of variables.

The study of the quantitative aspects of many phenomena in natural science is reduced to teaching and testing the functional relationship between the variables involved in it. For example, the ratio of the distance of the projectile flight in vacuum \( R \) to the initial velocity \( v_0 \) and the angle of the shot \( \alpha \) is calculated by the formula:

\[
R = \frac{v_0^2 \sin 2\alpha}{g}
\]

\( g \) - is the speed of gravity.
In the same way, the ratio of the limitation of the equilibrium state of the load \( y \) (wagon, car) installed on the spring, to the time \( t \) is related to the formula:

\[
y = e^{-kt}(A \cos wt + B \sin wt)
\]

Here \( k, A, B, w \) - are the accepted values of certain values for the system of quantities.

The study of many processes in natural sciences leads to the construction and study of a function, which is a mathematical model of this process. The above examples can be cited as evidence.

A function, which is a mathematical model of various processes, can be specified analytically (in the form of a formula), a tabular method, a graphical method and methods of verbal expression. Of all these methods, the most convenient is the analytical method, since it is easy and convenient to check it with this method.

Functions specified by the analytical method are divided into explicit and implicit functions.

If the relationship between \( x \) and \( y \) is expressed through \( y \), the function is considered explicit.

For example, a function \( y = 2x^2 - x + 3 \) is an explicit function.

If the relationship between \( x \) and \( y \) is not expressed in terms of \( y \), the function is considered implicit.

For example, functions \( F_1(x, y) = x^2 + y^2 - 1 = 0 \) \( F_2(x, y) = x \sin x + y \sin y - \pi = 0 \) are implicit functions.

Implicit functions can be specified as explicit functions. For example, an implicit function defined as an equation \( F_1(x, y) = x^2 + y^2 - 1 = 0 \) can be written as an explicit function. To do this, we solve the equation in relation \( y \).

\[
x^2 + y^2 - 1 = 0, \quad y^2 = 1 - x^2, \quad y = \pm\sqrt{1 - x^2}.
\]

However, a function defined as an implicit function cannot always be written as an explicit function. For example, it is rather difficult to write down functions such as, for example, given by the equations \( F_3(x, y) = x \sin x + y \sin y - \pi = 0 \) or \( F_5(x, y) = y \ln x - x^2 e^y + 1 = 0 \).

However, this does not mean that the functions given explicitly from what has been said cannot be studied. Because when solving many practical issues, they are faced with opaque functions and there is a need to study them. That is why in this article we will focus on checking the undisclosed function (determining the intersection points and asymptotes of the graph of the undisclosed function with the coordinate axes).

Consider a function defined as an implicit function of the equation \( F(x, y) = 0 \). Depending on whether the function is \( F(x, y) = 0 \) algebraic or transcendental, the graph curve of this function can also be algebraic or transcendental.

If the function \( F(x, y) \) can be multiplied \( \varphi_1(x, y), \varphi_2(x, y), \varphi_3(x, y), \ldots, \varphi_n(x, y) \), then this equation corresponds to the system of curves \( \varphi_1(x, y) = 0, \varphi_2(x, y) = 0, \varphi_3(x, y) = 0, \ldots, \varphi_n(x, y) = 0 \).

Let us dwell on some important factors that must be taken into account when constructing a function curve \( F(x, y) = 0 \).

If the curve does not change when you replace the curve \( x \) with the equation \(-x\) in the equation, the curve will be symmetrical to the ordinate axis.

If the curve does not change when the equation \( y \) is replaced with an equation \(-y\), the curve will be symmetrical to the abscissa axis.

If, when replacing the curve in the equation at the same time \( x \) by \(-x\) or \( y \) by \(-y\) the equation of the curve does not change, the curve will be symmetrical to the origin.

If, when replacing the curve in the equation \( y \) by \( x \) and \( x \) by \( y \) with participation the equation of...
the curve does not change, the curve will be symmetric to the bisector of angles I and III coordinates.

The graph of the function $F(x + a, y) = 0$ is formed by parallel shifting the abscissa of the graph of the function $F(x, y) = 0$ per unit distance $|a|$ (the opposite direction $a$ is taken here).

The graph of a function $F(x, y + b) = 0$ is formed by a parallel translation of the ordinate axis of the graph of the function $F(x, y) = 0$ per unit distance $|b|$ (the opposite direction $b$ is taken here).

The function graph $F\left(\frac{x}{p}, y\right) = 0$ is formed by a $p$-fold lengthening of the abscissa axis of the function graph $F(x, y) = 0$.

The graph of the function $F\left(x, \frac{y}{q}\right) = 0$ is formed by a $q$-fold lengthening of the ordinate axis of the graph of the function $F(x, y) = 0$.

Using the function graph $F(x, y) = 0$ using the above substitutions, you can get the function graph $F\left(\frac{x}{p} + a, \frac{y}{q} + b\right) = 0$.

From the system of points of intersection of the curve $F(x, y) = 0$ with the abscissa axis

$$\begin{cases}
F(x, 0) = 0 \\
F(x, y) = 0 \\
F(0, y) = 0 \\
F(x, y) = 0
\end{cases}$$

the system of points of its intersection with the ordinate axis is found

To obtain the most accurate curve $F(x, y) = 0$, in addition to the points of its intersection with the coordinate axes, it is also necessary to find additional points. As such points, it is advisable to take the points of intersection of this curve with the straight line $y = kx$ (with different meanings $k$).

If the equation $F(x, y) = 0$ can be written as $\varphi_1(x, y)\varphi_2(x, y) + \psi_1(x, y)\psi_2(x, y) = 0$ , in this case, the initially specified equation will satisfy the coordinates of the intersection points of the curves

$$\begin{cases}
\varphi_1 = 0 \\
\varphi_2 = 0 \\
\psi_1 = 0 \\
\psi_2 = 0
\end{cases}$$

To find the horizontal asymptote of the curve given by the equation $F(x, y) = 0$ highest degree coefficient $x$ equals to zero. If this coefficient does not change, there is no horizontal asymptote.

To find the vertical asymptote of the curve given by the equation $F(x, y) = 0$ the coefficient of the highest power of $y$ is zero.

To find the oblique asymptote of the curve given by the equation $F(x, y) = 0$ in this equation $y$ is replaced by $kx + b$, followed by the 2 highest exponent factors $x$ equates to zero, a system is formed, which is solved in relation to $k$ and $b$. If this coefficient does not change, there is no horizontal asymptote. The found values $k$ and $b$ are substituted into the equation $y = kx + b$. The resulting function is an oblique asymptote.

Example 1. Find the horizontal asymptote of the curve given by the equation $x^2y^2 + y^4 - 16x^2 = 0$.

Solution: $x^2y^2 + y^4 - 16x^2 = 0, \ (y^2 - 16)x^2 + y^4 = 0.$

The coefficient in front $x^2$ is equal to zero.

$$y^2 - 16 = 0$$

Hence $y - 4 = 0$ and $y + 4 = 0$ or $y = 4$ and $y = -4$. These are horizontal asymptotes.
Example 2. Find the vertical asymptote of the curve given by the equation \(3y^2 - xy^2 - 5x^2y = 0\).

Solution: \(3y^2 - xy^2 - 5x^2y = 0\), \((3-x)y^2 - 5x^2y = 0\), \(3 - x = 0\) or \(x = 3\) is the vertical asymptote. However, this curve also has a horizontal asymptote \(y = 0\).

Example 3. Find the oblique asymptote and intersection points with the coordinate system of the curve given by the equation \(x^3+y^3 - 3x^2 = 0\).

Solution. In the equation, \(y\) replace with \(kx + b\).

\[
x^3+y^3 - 3x^2 = 0, \quad x^3+(kx + b)^3 - 3x^2 = 0, \quad x^3+k^3x^3 + 3k^2x^2b + 3kxb^2 + +b^3 - 3x^2 = 0, \quad (1+k^3)x^3 + 3(bk^2 - 1)x^2 + 3b^2kx + b^3 = 0.
\]

Now let's create the following system:

\[
\begin{align*}
1+k^3 &= 0, \\
bk^2 - 1 &= 0.
\end{align*}
\]

From the first equation of the system we find \(k^3 = -1\), \(k = -1\). Let's substitute them into the second equation of the system.

\[
bk^2 - 1 = 0, \quad b(-1)^2 - 1 = 0, \quad b - 1 = 0, \quad b = 1
\]

So, the oblique asymptote of the given curve \(y = x + 1\).

Now let's find the points of intersection of the graph of the function with the coordinate system. For this, in the initially given equation, \(x\) we equate to zero. \(x^3+y^3 - 3x^2 = 0, \quad y^3 = 0, \quad y = 0\). So, the point \((0, 0)\) is the point of intersection of the graph of the function with the abscissa axis.

To find the point of intersection of the graph of the function with the \(y\)-axis in the given equation, \(y\) we equate to zero. \(x^3+y^3 - 3x^2 = 0, \quad x^3 - 3x^2 = 0, \quad x_1 = 0, \quad x - 3 = 0, \quad x_2 = 3.\) So, the point \((3, 0)\) is the point of intersection of the function graph with the ordinate axis.

Thus, in this article we have given examples of examples for finding the points of intersection with the coordinate axes of the graphs of functions, given in the form of implicit ones, as well as examples of examples for constructing the equations of the asymptotes of graphs of functions, since when fully examining the function and plotting its graph, it is important, along with determining the points of its intersection with the coordinate axes, to determine the asymptotes of the function graph. Other properties of an implicit function can also be defined without writing it as an explicit function.

**LITERATURE**


