ACADEMICIA: An International Multidisciplinary Research Journal
ISSN: 2249-7137 Vol. 12, Issue 05, May 2022 SJIF 2022 = 8.252
A peer reviewed journal

THE IMPORTANCE OF STUDYING $\varphi(x)=\cos(ax^2)$ FUNCTIONS IN STRENGTHENING STUDENTS' KNOWLEDGE OF TRIGONOMETRIC FUNCTIONS

Tojiyeva Muhabbatkhon Mansurjon qizi*

*Lecturer,
Department of Digital Technologies of Kokand University,
UZBEKISTAN
Email id: tojiyeva@gmail.com

DOI: 10.5958/2249-7137.2022.00367.6

ABSTRACT

This paper discusses the problem of determining and plotting the properties of functions of type with trigonometric functions. Trigonometric functions are included in the functions that represent many practical processes. In particular, when, the function is in views, and this function has different views and properties at different values of parameters. A number of scientific and methodological conclusions can be drawn from the study of cases occurring at different values of these parameters. Below are cases for the parameters of this function, the main properties of such functions are described in detail, and the graphs of the function are drawn in the modern graphic program GeoGebra.

KEYWORDS: *Function, Trigonometric Function, Quadratic Function, Function Properties, Function Graph.*

INTRODUCTION

The concepts of mathematical model and function are common in life, the problem of creating a mathematical model directly for the study of practical problems in economics, engineering, econometrics, physics and other fields is primary. The concept of function is one of the basic concepts of mathematics, its properties and the problem of drawing graphs have been studied extensively. From the textbooks of general secondary schools to the literature on higher mathematics, it can be seen that the concept of function and the study of its properties have been considered. However, although the literature defines the concept of a complex function, the problem of defining and plotting the properties of complex functions, the argument of which is a square function, is not mentioned. $y=f(ax^2+bx+c)$ It is important to determine the properties of the functions in the form of f trigonometric function and to draw a graph. Because the functions that represent many practical processes include trigonometric functions. In particular, when $f(x)=cosx$ is a function, it has $y=cos(ax^2+bx+c)$ views, and this function has different views and properties at different values of a,b,c parameters. A number of scientific and methodological conclusions can be drawn from the study of cases occurring at different values of these parameters. We will limit ourselves to the study of $a\neq 0$ $b=0$ $c=0$ cases below, taking into account the size of the article. Graphs of this type of function can be drawn using modern graphics programs GeoGebra and Maple. **[1-10]**

Let us be given function $\varphi(x)=\cos(ax^2)$ ($a \neq 0$). According to these $\cos(\alpha)=\cos(-\alpha)$ properties, when $a>0$ and $a<0$, the solutions overlap. Therefore, we consider this function in general for $a \neq 0$ cases.

- The domain of the function $\varphi(x)=\cos(ax^2)$ and the domain of the values are $D(x)=(-\infty;\infty)$, $E(y)=(-1;1)$, respectively;
- $\varphi(x)=\cos(ax^2)$ functions continuous.
- Determining the even, odd and periodicity of a function:

a) It follows that $\varphi(-x)=\cos a(-x)^2=\cos ax^2=\varphi(x)$ is a double function;

b) is not a periodic function, i.e., there are no $T \neq 0$ numbers satisfying $\varphi(x)=\varphi(x+T)$ equations. For real,

$$\varphi(x)=\cos\left(a(x+T)^2\right)=\cos(ax^2+2axT+aT^2)$$

$\varphi(x)=\varphi(x+T)$ must be $aT^2+2axT=2\pi k, k \in Z$ for equality to be fulfilled. Now let's solve the $aT^2+2axT=2\pi k, k \in Z$ square equation

$$aT^2+2axT-2\pi k=0, k \in Z \quad T_{1,2}=\frac{-2ax \pm \sqrt{4a^2x^2+8a\pi k}}{2a}$$

solutions. These solutions cannot be a function period because they depend on an unknown x.

- Find the points of intersection of the graph of the function $\varphi(x)=\cos ax^2$ with the coordinate axes:

  With Oy axes: $\varphi=1$ at $x=0$;

  With Ox axes: when $\varphi=0$:

$$\varphi(x)=\cos ax^2=0, \qquad ax^2=\frac{\pi}{2}+\pi k,\ x=\pm\sqrt{\frac{\pi+2\pi k}{2|a|}} \qquad k \in Z^+ \cup \{0\}$$

Thus, the graph of the function intersects the coordinate axes at points $O(0,1)$, $M\left(\sqrt{\frac{\pi+2\pi k}{2|a|}},0\right)$ $N\left(-\sqrt{\frac{\pi+2\pi k}{2|a|}},0\right)$ $k \in Z^+ \cup \{0\}$.

- Determine the intervals at which the sign of the function is stored, divide the area of detection into intervals by which the function is equal to zero. In each of these intervals we check the sign of the function:

It is known that the values of $y = \cos x$ functions are positive in the range $x \in (-\frac{\pi}{2} + 2\pi k, \frac{\pi}{2} + 2\pi k)$, and the graph is located on the axis Ox ; In the interval $x \in (\frac{\pi}{2} + 2\pi k, \frac{3\pi}{2} + 2\pi k)$, the values of the function are located under the axis of the negative graph. Using these properties, we get:

1. $-\frac{\pi}{2} + 2\pi k < ax^2 < \frac{\pi}{2} + 2\pi k, \quad -\frac{\pi}{2a} + \frac{2\pi k}{a} < x^2 < \frac{\pi}{2a} + \frac{2\pi k}{a}, k \in Z$

$$x \in \left(-\sqrt{\frac{\pi + 4\pi k}{2a}}, -\sqrt{\frac{-\pi + 4\pi k}{2a}}\right) \cup \left(\sqrt{\frac{-\pi + 4\pi k}{2a}}, \sqrt{\frac{\pi + 4\pi k}{2a}}\right) \cup \left(-\sqrt{\frac{\pi}{2a}}, \sqrt{\frac{\pi}{2a}}\right) k \in Z^+$$

The values of the function in the interval are positive, located on the axis of the graph.

2. $\frac{\pi}{2} + 2\pi k < ax^2 < \frac{3\pi}{2} + 2\pi k, \quad \frac{\pi}{2a} + \frac{2\pi k}{a} < x^2 < \frac{3\pi}{2a} + \frac{2\pi k}{a}, k \in Z$

$$x \in \left(-\sqrt{\frac{3\pi + 4\pi k}{2a}}, -\sqrt{\frac{\pi + 4\pi k}{2a}}\right) \cup \left(\sqrt{\frac{\pi + 4\pi k}{2a}}, \sqrt{\frac{3\pi + 4\pi k}{2a}}\right) k \in Z^+ \cup \{0\}$$

The value of the function in the interval is negative, located below the axis of the graph.

- $\varphi(x) = \cos(ax^2)$ The graph of a function has no asymptotes.
- Find the monotonic intervals of a function and check for extremum

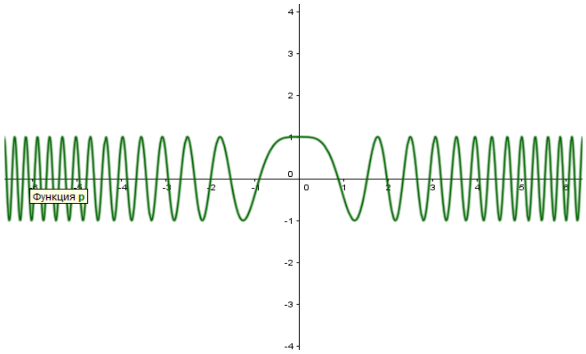
 We get the product of $\varphi(x) = \cos(ax^2)$ functions:

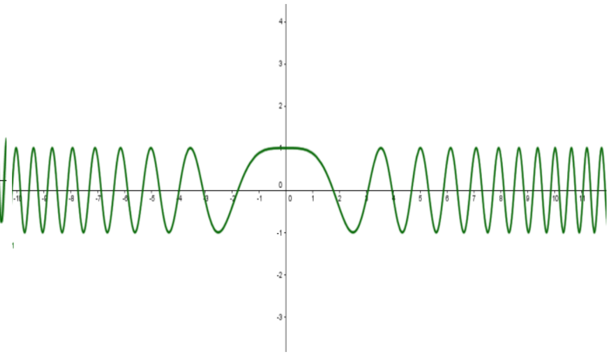
 $y' = (\cos ax^2)' = -a \cdot 2x \cdot \sin ax^2 = 0$

 $x_1 = 0, \qquad ax^2 = \pi k \quad \Rightarrow x_{2,3} = \pm\sqrt{\frac{\pi k}{|a|}} \quad k \in Z^+ \cup \{0\}$,

where x_1, x_2, x_3 points are the critical points of the $\varphi(x)$ function. the point is derived from the value of the points.

- The axis of symmetry of the graph of the function $\varphi(x) = cos(ax^2)$ is $x = 0$ lines, because it is a pair of functions
- Draw a graph of a function:





- Figure 1 ($\varphi(x) = cos(2x^2)$) Figure 2 ($\varphi(x) = cos\left(\frac{x^2}{2}\right)$)

CONCLUSION

The properties of these $\varphi(x) = \cos(ax^2)$ types of functions are similar to those of $f(x) = cosx$ functions, that is, they have the same domain of definition, the same domain of values, and both are even functions. The graphs are symmetrical about the axis of the MOON, but the main difference is that $\varphi(x) = \cos(ax^2)$ functions are not periodic. **[11-17]**

The study of such functions is of interest to students and can be given as a subject of independent study. Because the sequence of rules for determining the properties of graphs and graphing is familiar to them, through such topics it is possible to form their creative approach, the ability to apply the rules in different situations. You will also be able to draw graphs using modern computer programs.

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