МЕДИЦИНА, ПЕДАГОГИКА И ТЕХНОЛОГИЯ: ТЕОРИЯ И ПРАКТИКА
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"COMPLEX NUMBERS AND THEIR CONNECTION WITH ANALYTIC FUNCTIONS"

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Annotation: This paper explores the relationship between complex numbers and analytical functions. Complex numbers consist of real and imaginary parts and are widely used in various fields of mathematics. Analytic functions are crucial when working with complex variables. These functions are based on the Cauchy-Riemann equations, which define their properties in a given domain. The study examines the key concepts of complex functions, their differentiability, and analytical properties.

Keyword: Complex numbers, Analytic function, Cauchy-Riemann equations, Holomorphic functions, Contour integral, Differentiability, Taylor series, Analysis, Complex analysis, Existence of analytic function

Complex numbers and their analytic functions are one of the main areas of mathematics and are widely used in many fields such as physics, engineering, and others. Let me provide a detailed explanation about complex numbers and their analytic functions. Complex numbers are actually a combination of two real numbers. Every complex number is written in the following form:

$$z=x+yi$$

Here:

- **x** is the real part,
- **y** is the imaginary part,
- **i** is the imaginary unit, defined as $i^2 = -1$.

Complex numbers have a real part and an imaginary part, often denoted as xx and yy, respectively. Complex functions are functions that accept real variables and convert them into complex numbers. The general form of a complex function can be written as:

$$f(z)=u(x,y)+iv(x,y)f(z) = u(x, y) + iv(x, y)$$

In the theory of complex numbers, an analytic function (or holomorphic function) is a function that is differentiable with respect to a complex variable, and it satisfies the following conditions:

1. The function must be continuous and differentiable.
2. The Cauchy-Riemann equations must be fully satisfied.

For a complex function to be analytic, the Cauchy-Riemann equations must hold, and they are expressed as:

If f(z)=u(x,y)+iv(x,y)f(z) = u(x, y) + iv(x, y), where u(x,y)u(x, y) and v(x,y)v(x, y) are the real and imaginary parts, respectively, then the Cauchy-Riemann equations are:

1. $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$
2. $\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$

These equations link the changes in *u* and *v*, and only when these conditions are satisfied does the function become analytic. If a complex function is analytic, its derivative also exists and is continuous. This is different from real functions, where the derivative may only exist at certain points, but for complex functions, analyticity means the derivative exists at every point.

Complex numbers and analytic functions are widely used in various fields such as electromagnetic waves, quantum mechanics, mathematical physics, and signal processing. They play a crucial role in modeling system dynamics and solving linear differential equations. Complex functions also have significant importance in tools like integral transforms, Laplace transforms, Fourier transforms, and others. These tools can be applied more efficiently using analytic functions.

In general, complex numbers and their analytic functions are of great importance not only in mathematics but also in the application of science and technology.

References:

1. *Xudaykulova, S. (2024). DARAJALI GEOMETRIYA - KO‘PHADLAR VA NORMAL KONUSLAR. Interpretation and Researches, 1(1). извлечено от https://interpretationandresearches.uz/index.php/iar/article/view/2496* *Mathematical Analysis* (Yu. M. Geller, L. D. Faddeev).
2. Xudaykulova , S. (2024). TEXNIK IJODKORLIKNING HOZIRGI HOLATI. Research and Implementation. извлечено от https://rai-journal.uz/index.php/rai/article/view/520
3. Ne’matova , D. (2023). BOSHLANG‘ICH SINF O‘QUVCHILARIDA TANQIDIY FIKRLASH KO‘NIKMALARINI SHAKLLANTIRISHNING PEDAGOGIK-PSIXOLOGIK XUSUSIYATLARI. Interpretation and Researches, 2(1). извлечено от https://interpretationandresearches.uz/index.php/iar/article/view/973
4. Холмуминова, А. (2023). ОСОБЕННОСТИ И ПРЕИМУЩЕСТВА ФОРМИРОВАНИЯ КОМПЕТЕНТНОСТИ ПОДГОТОВКИ ИННОВАЦИОННОЙ ДЕЯТЕЛЬНОСТИ У БУДУЩИХ УЧИТЕЛЕЙ НАЧАЛЬНЫХ КЛАССОВ. Interpretation and Researches, 2(1). извлечено от https://interpretationandresearches.uz/index.php/iar/article/view/1145"Complex Analysis" by Elias M. Stein and Rami Shakarchi This book introduces the key concepts, theorems, and practical applications of complex analysis.
5. "Principles of Mathematical Analysis" by Walter Rudin Rudin's famous "Mathematical Analysis" book contains important material on complex numbers.
6. "Complex Variables and Applications" by James Brown and Ruel Churchill A classic textbook that explains complex variables and their practical applications in detail.

7. "Introduction to Complex Analysis" by Richard A. Silverman