International Journal on Integrated Education
https://journals.researchparks.org/index.php/IJIE
e-ISSN : 2620 - 3502
p-ISSN : 2615 - 3785

DEFINITION OF COMPLEX FUNCTIONS AND CALCULATION OF THEIR DERIVATIVES USING SIMPLE METHODS

Rafikov Fakhriddin Kahakhorovich
Teacher of the Kokan State Pedagogical Institute

1 ^{0}. Two function yi đ index , difference , multiplication and of the ratio derivative . let's say $f(x)$ and $g(x)$ functions $(a,b)\subset R$ given in being _ $x_0 \in (a,b)$ at the point $f'(x_0)$ and $g'(x_0)$ to derivatives have let it be Derivative to the definition according to

$$\lim_{x\to x_0}\frac{f(x)-f(x_0)}{x-x_0}=f'(x_0),(1)$$

$$\lim_{x\to x_0}\frac{g(x)-g(x_0)}{x-x_0}=g'(x_0) \qquad (2)$$

will be

1) $f(x)\pm g(x)$ function x_0 at the point to the derivative have being _

$$(f(x)\pm g(x))'_{x_0}=f'(x_0)\pm g'(x_0)$$

will be

◄ $F(x)=f(x)\pm g(x)$ that we find :

$$\frac{F(x)-F(x_0)}{x-x_0}=\frac{f(x)-f(x_0)}{x-x_0}\pm\frac{g(x)-g(x_0)}{x-x_0}.$$

This in equality $x\to x_0$ at to the limit passing , relations (1) and (2) above **e** `attention if we can , then

$$\lim_{x\to x_0}\frac{F(x)-F(x_0)}{x-x_0}=\lim_{x\to x_0}\frac{f(x)+f(x_0)}{x-x_0}\pm$$

$$\pm\lim_{x\to x_0}\frac{g(x)-g(x_0)}{x-x_0}=f'(x_0)\pm g'(x_0)$$

to be come comes out So ,

$$F'(x_0)=(f(x)\pm g(x))'_{x_0}=f'(x_0)\pm g'(x_0).►$$

2) $f(x)\cdot g(x)$ function x_0 at the point to the derivative have being _

$$(f(x)\cdot g(x))'_{x_0}=f'(x_0)\cdot g(x_0)\pm f(x_0)\cdot g'(x_0)$$

will be

◄ $\Phi(x)=f(x)\cdot g(x)$ that

$$\frac{\Phi(x)-\Phi(x_0)}{x-x_0}$$

ratio as follows

e-ISSN : 26203502
p-ISSN : 26153785

$$\frac{\Phi(x)-\Phi(x_0)}{x-x_0}=\frac{f(x)-f(x_0)}{x-x_0}\cdot g(x_0)+\frac{g(x)-g(x_0)}{x-x_0}\cdot f(x)$$

writing we can After $x \to x_0$ to the limit at past we find :

$$\lim_{x\to x_0}\frac{\Phi(x)-\Phi(x_0)}{x-x_0}=g(x_0)\cdot\lim_{x\to x_0}\frac{f(x)-f(x_0)}{x-x_0}+\lim_{x\to x_0}\frac{g(x)-g(x_0)}{x-x_0}\cdot f(x)=$$

$$=f'(x_0)\cdot g(x_0)+f(x_0)\cdot g'(x_0).$$

So ,

$$\Phi'(x_0)=\left(f(x)\cdot g(x)\right)'_{x_0}=f'(x_0)\cdot g(x_0)+f(x_0)\cdot g'(x_0)►$$

3) $\frac{f(x)}{g(x)}$ function $(g(x_0)\neq 0)$ x_0 at the point to the derivative have being _

$$\left(\frac{f(x)}{g(x)}\right)'_{x_0}=\frac{f'(x_0)\cdot g(x_0)-f(x_0)\cdot g'(x_0)}{g^2(x_0)}$$

will be

◄ As long as $g(x_0)\neq 0$ if , then x_0 of the point something around x in $g(x)\neq 0$ will be THAT attention take we find :

$$\frac{\frac{f(x)}{g(x)}-\frac{f(x_0)}{g(x_0)}}{x-x_0}=\frac{f(x)\cdot g(x_0)-f(x_0)\cdot g(x_0)+f(x_0)\cdot g(x_0)-f(x_0)\cdot g(x)}{g(x)\cdot g(x_0)\cdot(x-x_0)}=$$

$$=\frac{1}{g(x)\cdot g(x_0)}\left[\frac{f(x)-f(x_0)}{x-x_0}\cdot g(x_0)-f(x_0)\cdot\frac{g(x)-g(x_0)}{x-x_0}\right].$$

this equation $x \to x_0$ to the limit at past , this

$$\left(\frac{f(x)}{g(x)}\right)'_{x_0}=\frac{f'(x_0)\cdot g(x_0)-f(x_0)\cdot g'(x_0)}{g^2(x_0)}$$

to equality we will come ► $\left(\frac{2x-x^3}{\ln x}\right)_{x=x_0}$ in derivative let's count . In this case, if x=e ,

$$\left(\frac{2x-x^3}{\ln x}\right)'_{x=x_0}=\frac{\left(2x-x^3\right)'\ln x-\left(2x-x^3\right)\left(\ln x\right)'}{\left(\ln x\right)^2}$$

$\left(2x-x^3\right)'=2-3x^2$ $\quad \left(\ln x\right)'=\frac{x'}{x}=\frac{1}{x}$ so answer as follows harvest will be done .

$$\left.\frac{\left(2-3x^2\right)\ln x-\left(2-x^2\right)}{\left(\ln x\right)^2}\right|_{x=x_0=e}=2-3e^2-2+e^2=-2e^2$$

Result 1 . If $f(x)$ function x_0 at the point $f'(x_0)$ to the derivative have if _ _ _ $c\cdot f(x)$

e-ISSN : 26203502
p-ISSN : 26153785

function $(c = const)$ x_0 at the point to the derivative have be _ _ _

$$(c \cdot f(x))'_{x_0} = c \cdot f'(x_0)$$

will be , that is unchanging thigh derivative from the hint out release can _

Result 2 . If $f_1(x),\ f_2(x), ..., \ f_n(x)$ functions x_0 at the point to derivatives have being _ $c_1,\ c_2, ..., c_n$ unchanging numbers if , then

$$(c_1 f_1(x) + c_2 f_2(x) + ... + c_n f_n(x))'_{x_0} = c_1 f_1'(x_0) + c_2 f_2'(x_0) + ... + c_n f_n'(x_0)$$

will be

2 ^{0} . Complicated of the function derivative . Hypothesis let's do $y = f(x)$ function $X \subset R$ in $g(y)$the collection function $\{f(x) | x \in X\}$ in the collection given being _$x_0 \in X$ at the point $f'(x_0)$ to the derivative , $y_0 \in \{f(x) | \ x \in X\}$ at the point $(y_0 = f(x_0))$ $g'(y_0)$ to the derivative have let it be In that case $g(f(x))$ complicated function x_0 at the point to the derivative have being _

$$(g(f(x)))'_{x_0} = g'(f(x_0)) \cdot f'(x_0)$$

will be

◄ $g(y)$ of the function y_0 at the point $g'(y_0)$ to the derivative have because it was

$$g(y) - g(y_0) = g'(y_0) \cdot (y - y_0) + \alpha \cdot (y - y_0)$$

to be come it turns out that

$y = f(x),\ y_0 = f(x_0)$ and $y \to y_0$at $\alpha \to 0$_

Next of equality each two side $x - x_0$ to being we find :

$$\frac{g(f(x)) - g(f(x_0))}{x - x_0} = g'(f(x_0)) \cdot \frac{f(x) - f(x_0)}{x - x_0} + \alpha \frac{f(x) - f(x_0)}{x - x_0}.$$

From this $x \to x_0$to the limit at passed _

$$(g(f(x)))'_{x_0} = g'(f(x_0)) \cdot f'(x_0)$$

to equality we will come ►

30 . - The opposite of the function derivative . let's say $y = f(x)$ function (a,b) is given in , continuous and strictly increasing (constant decreasing) being _ $x_0 \in (a,b)$ at the point $f'(x_0)$ $(f'(x_0) \neq 0)$ to the derivative have let it be In that case $x = f^{-1}(y)$ function y_0 $(y_0 = f(x_0))$ at the point to the derivative have and

$$[f^{-1}(y)]'_{x_0} = \frac{1}{f'(x_0)}$$

will be

◄ Ravshanka ,

$$f(x) - f(x_0) = f'(x_0)(x - x_0) + \alpha(x - x_0)$$

being and $x \to x_0$_$\alpha \to 0$ will be This from equality

$$y - y_0 = f'(x_0)[f^{-1}(y) - f^{-1}(y_0)] - \alpha[f^{-1}(y) - f^{-1}(y_0)] =$$

e-ISSN : 26203502
p-ISSN : 26153785

$$=\left[f^{-1}(y)-f^{-1}(y_0)\right]\cdot\left[f'(x_0)+\alpha\right]$$

to expression we will come From this while

$$\frac{f^{-1}(y)-f^{-1}(y_0)}{y-y_0}=\frac{1}{f'(x_0)+\alpha}$$

to be come comes out

Next in equality $y \to y_0$ to the limit at past we find :

$$\left[f^{-1}(y)\right]'_{y_0}=\frac{1}{f'(x_0)}.\ ►$$

4 ⁰. Examples . Example 1 . $\left(x^{\alpha}\right)'=\alpha x^{\alpha-1}$ will be , $\alpha \in R,\ x>0.$

◄ Let's say $x>0$ let it be In it $f(x)=x^{\alpha}$ function for

$$\frac{(x+\Delta x)^{\alpha}-x^{\alpha}}{\Delta x}=x^{\alpha-1}\cdot\frac{\left(1+\frac{\Delta x}{x}\right)^{\alpha}-1}{\frac{\Delta x}{x}}$$

being _ $\Delta x \to 0$ at $\left(x^{\alpha}\right)'=\alpha x^{\alpha-1}$ will be ►

Example 2 . $\left(a^{x}\right)'=a^{x}\ln a$ will be , $a>0,\ x\in R.$

◄ $f(x)=a^{x}$ function for

$$\frac{a^{x+\Delta x}-a^{x}}{\Delta x}=a^{x}\cdot\frac{a^{\Delta x}-1}{\Delta x}$$

being _ $\Delta x \to 0$ at $\left(a^{x}\right)'=a^{x}\ln a$ will be ►

Example 3 . $(\sin x)'=\cos x, (\cos x)'=-\sin x$ will be $x\in R$_

◄ $f(x)=\sin x$ function for

$$\frac{\sin(x+\Delta x)-\sin x}{\Delta x}=2\cdot\frac{1}{\Delta x}\cdot\sin\frac{\Delta x}{2}\cos\left(x+\frac{\Delta x}{2}\right)=\frac{\sin\frac{\Delta x}{2}}{\frac{\Delta x}{2}}\cos\left(x+\frac{\Delta x}{2}\right)$$

being _ $\Delta x \to 0$ at $(\sin x)'=\cos x$ will be The same _ that's it similar $(\cos x)'=-\sin x$ to be found ►

Example 4 . $(\log_a x)'=\frac{1}{x\ln a}$ b dies , $a>0,\ a\neq 1,$ _ $x>0.$

◄ $f(x)=\log_a x$ function for

$$\frac{\log_a(x+\Delta x)-\log_a(x)}{\Delta x}=\frac{1}{\Delta x}\log_a\left(1+\frac{\Delta x}{x}\right)=\frac{1}{x}\log_a\left(1+\frac{\Delta x}{x}\right)^{\frac{x}{\Delta x}}$$

e-ISSN : 26203502
p-ISSN : 26153785

being _ $\Delta x \to 0$ at

$$(\log_a x)' = \frac{1}{x}\log_a e = \frac{1}{x\ln a}$$

will be In particular , $(\ln x)' = \frac{1}{x}$ will be ►

Example 5 . $(arctgx)' = \frac{1}{1+x^2}$ will be

◄ Reverse function derivative count to the formula basically $(y = arctgx,\ \ x = tgy)$

$$y' = (arctgx)' = \frac{1}{(tgy)'} = \cos^2 y = \frac{1}{1+tg^2 y} = \frac{1}{1+x^2}$$

will be
Same that's it similar to

$$(\arcsin x)' = \frac{1}{\sqrt{1-x^2}} \qquad (x \in (-1,\ 1)),$$

$$(\arccos x)' = -\frac{1}{\sqrt{1-x^2}} \qquad (x \in (-1,\ 1)),$$

$$(arcctgx)' = -\frac{1}{1+x^2}$$

will be .►

Example 6 . Hypothesis let's do

$$y = [u(x)]^{v(x)} \qquad (u(x) > 0)$$

being _ $u'(x)$ and $v'(x)$ are available let it be In that case

$$\left([u(x)]^{v(x)}\right)' = [u(x)]^{v(x)} \cdot \left[v'(x)\ln u(x) + \frac{v(x)}{u(x)}u'(x)\right]$$

will be _ _

◄ This $y = [u(x)]^{V(x)}$ n i logarithmically ,

$$\ln y = v(x)\ln u(x),$$

then we find the derivative of a complex function using the calculation rule:

$$\frac{1}{y}y' = v'(x)\cdot\ln u(x) + v(x)\cdot\frac{1}{u(x)}\cdot u'(x),$$

$$y' = y\left[v'(x)\cdot\ln u(x) + v(x)\cdot\frac{v(x)}{u(x)}\cdot u'(x)\right] =$$

$$= [u(x)]^{v(x)} \cdot \left[v'(x)\ln u(x) + \frac{v(x)}{u(x)}u'(x)\right]. \ ►$$

this,

$$(u^v)' = u^v \cdot \ln u \cdot v' + v \cdot u^{v-1} \cdot u'. \qquad (3)$$

e-ISSN : 26203502
p-ISSN : 26153785

from equality , $y = u^v$ function derivative of calculation the following the rule come out : $y = u^v$ of the function derivative two from the joiner consists of being the first joiner u^v the indicative is taken as a function to the derivative (in which basis $u(x)$ is considered unchangeable) the second joiner while u^v the level is taken as a function to the derivative (in which degree indicator $v(x)$ is considered unchanged) is equal will be

Example 7 . This

$$f(x) = x^x, g(x) = x^{x^x}$$

of functions derivatives be found

◄ From formula (3). using we find :

$$f'(x) = \left(x^x\right)' = x^x \cdot \ln x + x \cdot x^{x-1} = x^x(\ln x + 1),$$

$$g'(x) = \left(x^{x^x}\right)' = \left(x^{f(x)}\right)' = x^{f(x)} \cdot \ln x \cdot f'(x) + f(x) \cdot x^{f(x)-1} =$$

$$= x^{x^x} \cdot \ln x \cdot (x^x(\ln x + 1)) + x^{x^x} \cdot x^{x^x - 1} =$$

$$= x^{x^x + x - 1}(x^x \ln x(\ln x + 1) + 1).$$ ►

References

1.Leger G., Luks E. Generalized Derivations of Lie algebras, J. Algebra, 2000, 228,165-203.
2.Hartwig J., Larsson D.,Silvestrov S. Deformation of Lie algebras using (σ, τ)- derivation. Journal of algebra,2006, 38 (2) 109-138.
3.Hrivnak J.Invariants of Lie algebras. PhD Thesis, Faculty of Nuclear Science andPhysical Engineering, Czech Technical University, Prague, 2007.
4.Novotny P.,Hrivnak J. On (α, β, γ)-derivation of Lie algebras and correspondinginvariant functions. J. Geom. Phys.,2008, 58, 208-217.
5.Rakhimov I. S., Said Husain Sh. K.,Abdulkadir A. On Generalized derivationsof finite dimensional associative algebras. FEIIC International journal of Engineering andTechnology,2016, 13 (2) 121-126.
6.Fiidow M.A., Rakhimov I.S., Said Husain Sh.K., Basri W. (α, β, γ)-Derivations of diassociativealgebras. Malaysian Journal Of Mathematical ciences, 2016, 10101- 126.
7. McCrimmonK.A taste of Jordan algebras.Springer, New York, Berlin, Heidelberg, Hong Kong, London, Milan, Paris, Tokyo, 2004, pp. 562.
8. Hanche-OlcenH., StörmerE.Jordan operator algebras.Boston etc: Pitman Publ. Inc.,1984, pp. 183.
9. Ergashev A. A., Vakhobov F. F. THE ESSENCE OF THE CONCEPT OF" PROFESSIONAL ACTIVITY OF A MATHEMATICS TEACHER" //Open Access Repository. – 2022. – T. 8. – №. 12. – C. 147-154.
10.Yigitalievich A. U., Fazliddin V. A SYSTEM OF EQUATIONS FOR OSCILLATION AND STABILITY OF A VISCOELASTIC PLATE TAKING INTO ACCOUNT THE GENERALIZED HEAT CONDUCTIVITY EQUATIONS “JOURNAL OF SCIENCE-INNOVATIVE RESEARCH IN UZBEKISTAN” JURNALI VOLUME 1, ISSUE 8, 2023. NOVEMBER ResearchBib Impact Factor: 8.654/2023 ISSN 2992-8869 337 //Galaxy International Interdisciplinary Research Journal. – 2022. – T. 10. – №. 12. – C. 304-308.

e-ISSN : 26203502
p-ISSN : 26153785

11.Makhmudov B. B., Vokhobov F. F. TOPICS: GAUSS'S THEOREM. INTEGRAL EXPRESSION OF THE HYPERGEOMETRIC FUNCTION ACCORDING TO THE DALANBER PRINCIPLE //Galaxy International Interdisciplinary Research Journal. – 2022. – T. 10. – №. 12. – C. 138-144.
12.Yigitalievich A. U., Mirsaid S. SYSTEM OF EQUATIONS OF COUPLED DYNAMIC PROBLEMS OF A VISCOELASTIC SHELL IN A TEMPERATURE FIELD //Galaxy International Interdisciplinary Research Journal. – 2022. – T. 10. – №. 12. – C. 298-303.
13.Faxriddinjon o'g'li V. F. et al. HYPERGEOMETRIC FUNCTIONS OF SEVERAL VARIABLES //Open Access Repository. – 2023. – T. 9. – №. 6. – C. 250-252.
14.Faxriddinjon o'g'li V. F. et al. EXPANSIONS OF HYPERGIOMETRIC FUNCTIONS OF SEVERAL VARIABLES ACCORDING TO KNOWN FORMULAS //Galaxy International Interdisciplinary Research Journal. – 2023. – T. 11. – №. 6. – C. 548-550.
15.Faxriddinjon o'g'li V. F. On Generalized Derivations Of Jordon Algebras //Open Access Repository. – 2022. – T. 9. – №. 11. – C. 340-343