UNIVERSIDAD DEL SURESTE

"Pasión por educar"

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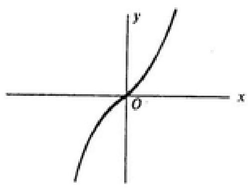
MATERIA:MATEMATICAS APLICADA

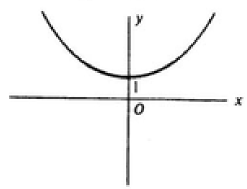
REPRESENTACIÓN GRÁFICA DE LAS FUNCIONES HIPERBÓLICAS

En todas las gráficas *x* está dado en radianes

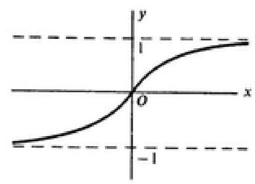
$y = \text{senh } x$



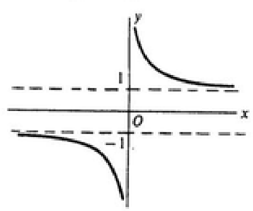
$y = \cosh x$



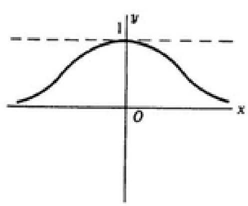
$y = \text{tgh } x$



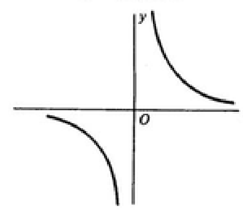
$y = \text{cotgh } x$



$y = \text{sech } x$

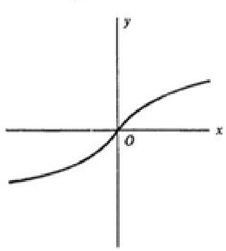


$y = \text{cosech } x$

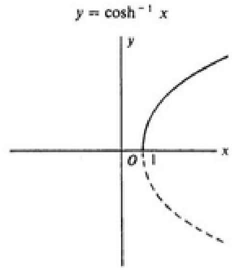


REPRESENTACIÓN GRÁFICA DE LAS FUNCIONES HIPERBÓLICAS INVERSAS

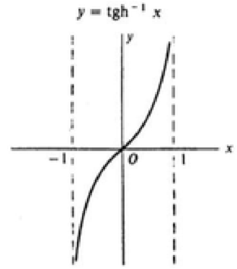
$y = \text{senh}^{-1} x$



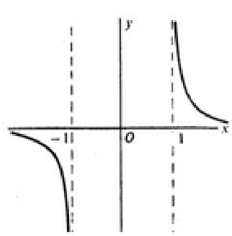
$y = \cosh^{-1} x$



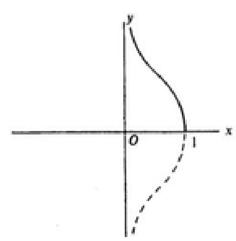
$y = \text{tgh}^{-1} x$



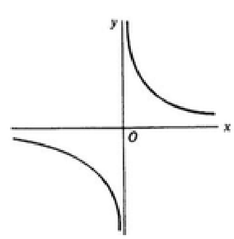
$y = \text{cotgh}^{-1} x$



$y = \text{sech}^{-1} x$



$y = \text{cosech}^{-1} x$



Formulario Funciones Hiperbólicas

A.L.B.S. / N.M.G.

Definición Funciones Hiperbólicas

$$\operatorname{senh} x = \frac{e^{x} - e^{-x}}{2} \qquad \cosh x = \frac{e^{x} + e^{-x}}{2}$$

$$\tanh x = \frac{\operatorname{senh} x}{\cosh x} = \frac{e^{x} - e^{-x}}{e^{x} + e^{-x}} \qquad \coth x = \frac{\cosh x}{\operatorname{senh} x} = \frac{e^{x} + e^{-x}}{e^{x} - e^{-x}},\ x \neq 0$$

$$\operatorname{sech} x = \frac{1}{\cosh x} = \frac{2}{e^{x} + e^{-x}} \qquad \operatorname{csch} x = \frac{1}{\operatorname{senh} x} = \frac{2}{e^{x} - e^{-x}},\ x \neq 0$$

Identidades de Funciones hiperbólicas

$$\cosh^2 x - \operatorname{senh}^2 x = 1 \qquad \tanh^2 x + \operatorname{sech}^2 x = 1 \qquad \coth^2 x - \operatorname{csch}^2 x = 1$$

$$\operatorname{senh}(x + y) = \operatorname{senh} x \cosh y + \cosh x \operatorname{senh} y$$

$$\operatorname{senh}(x - y) = \operatorname{senh} x \cosh y - \cosh x \operatorname{senh} y$$

$$\cosh(x + y) = \cosh x \cosh y + \operatorname{senh} x \operatorname{senh} y$$

$$\cosh(x - y) = \cosh x \cosh y - \operatorname{senh} x \operatorname{senh} y$$

$$\operatorname{senh} 2x = 2 \operatorname{senh} x \cosh x \qquad \cosh 2x = \cosh^2 x + \operatorname{senh}^2 x$$

$$\cosh 2x = 2 \operatorname{senh}^2 x + 1 \qquad \cosh 2x = 2 \cosh^2 x - 1$$

Derivadas de las funciones hiperbólicas

$$\frac{d}{dx}(\operatorname{senh} u) = \cosh u \frac{du}{dx} \qquad \frac{d}{dx}(\cosh u) = \operatorname{senh} u \frac{du}{dx}$$

$$\frac{d}{dx}(\tanh u) = \operatorname{sech}^2 u \frac{du}{dx} \qquad \frac{d}{dx}(\coth u) = -\operatorname{csch}^2 u \frac{du}{dx}$$

$$\frac{d}{dx}(\operatorname{sech} u) = -\operatorname{sech} u \tanh u \frac{du}{dx} \qquad \frac{d}{dx}(\operatorname{csch} u) = -\operatorname{csch} u \coth u \frac{du}{dx}$$

Integrales de las funciones hiperbólicas.

$$\int \operatorname{senh} u\, du = \cosh u + c \qquad \int \cosh u\, du = \operatorname{senh} u + c$$

$$\int \tanh u\, du = \ln \cosh u + c \qquad \int \operatorname{sech}^2 u\, du = \tanh u + c$$

$$\int \operatorname{csch}^2 u\, du = -\coth u + c \qquad \int \operatorname{sech} u \tanh u\, du = -\operatorname{sech} u + c$$

$$\int \operatorname{csch} u \coth u\, du = -\operatorname{csch} u + c$$

Funciones hiperbólicas inversas

$$\operatorname{ang senh} x = \ln\left(x + \sqrt{x^2 + 1}\right) \qquad \operatorname{ang cosh} x = \ln\left(x + \sqrt{x^2 - 1}\right) \quad x \geq 1$$

$$\operatorname{ang tanh} x = \frac{1}{2} \ln\left(\frac{1 + x}{1 - x}\right) \quad |x| < 1 \qquad \operatorname{ang coth} x = \frac{1}{2} \ln\left(\frac{x + 1}{x - 1}\right) \quad |x| > 1$$

$$\operatorname{ang sech} x = \ln\left(\frac{1}{x} + \frac{\sqrt{1 - x^2}}{x}\right) \quad 0 < x \leq 1 \qquad \operatorname{ang csch} x = \ln\left(\frac{1}{x} + \frac{\sqrt{1 + x^2}}{|x|}\right) x \neq 0$$

Derivadas Funciones Hiperbólicas inversas

$$\frac{d}{dx} \operatorname{ang senh} u = \frac{1}{\sqrt{u^2 + 1}} \frac{du}{dx} \qquad \frac{d}{dx} \operatorname{ang cosh} u = \frac{1}{\sqrt{u^2 - 1}} \frac{du}{dx} \quad u > 1$$

$$\frac{d}{dx} \operatorname{ang tanh} u = \frac{1}{1 - u^2} \frac{du}{dx} \quad |u| < 1$$

$$\frac{d}{dx} \operatorname{ang coth} u = \frac{1}{1 - u^2} \frac{du}{dx} \quad |u| > 1$$

$$\frac{d}{dx} \operatorname{ang sech} u = -\frac{1}{u\sqrt{1 - u^2}} \frac{du}{dx} \quad 0 < u < 1$$

$$\frac{d}{dx} \operatorname{ang csch} u = -\frac{1}{|u|\sqrt{1 + u^2}} \frac{du}{dx} \quad u \neq 0$$

Integrales para Funciones Hiperbólicas inversas

$$\int \frac{du}{\sqrt{a^2 + u^2}} = \operatorname{ang senh} \frac{u}{a} + c = \ln\left(u + \sqrt{u^2 + a^2}\right) + c$$

$$\int \frac{du}{\sqrt{u^2 - a^2}} = \operatorname{ang cosh} \frac{u}{a} + c = \ln\left(u + \sqrt{u^2 - a^2}\right) + c \quad u > a$$

$$\int \frac{du}{a^2 - u^2} = \begin{cases} \frac{1}{a} \operatorname{ang tanh} \frac{u}{a} + c, & |u| < a \\ \frac{1}{a} \operatorname{ang coth} \frac{u}{a} + c, & |u| > a \end{cases} = \frac{1}{2a} \ln\left|\frac{a + u}{a - u}\right| + c \quad u \neq a$$

$$\int \frac{du}{u\sqrt{1 - u^2}} = -\operatorname{ang sech} u + c = -\ln\left(\frac{1}{u} + \frac{\sqrt{1 - u^2}}{u}\right), \quad 0 < u < 1$$

$$\int \frac{du}{|u|\sqrt{1 - u^2}} = -\operatorname{ang csch} u + c = -\ln\left(\frac{1}{u} + \frac{\sqrt{1 + u^2}}{|u|}\right), \quad u \neq 1$$

Fórmulas de Integración

$$\int 0dx = C$$
$$\int k\,dx = kx + C$$
$$\int kf(x)dx = k\int f(x)dx$$
$$\int [f(x) \pm g(x)]dx = \int f(x)dx \pm \int g(x)dx$$
$$\int x^{n}dx = \frac{x^{n+1}}{n+1} + C, n \neq -1$$
$$\int \cos x dx = sen x + C$$
$$\int sen x dx = -\cos x + C$$
$$\int \sec^2 x dx = \tan x + C$$
$$\int \sec x \tan x dx = \sec x + C$$
$$\int \csc^2 x dx = -\cot x + C$$
$$\int \csc x \cot x dx = -\csc x + C$$
$$\int \tan u du = \ln|\sec u| + C$$
$$\int \cot u du = \ln|sen u| + C$$
$$\int \sec u du = \ln|\sec u + \tan u| + C$$
$$\int \csc u du = \ln|\csc u - \cot u| + C$$
$$\int uv' dx = uv - \int u' v dx$$
$$\int u^n du = \frac{1}{n+1}u^{n+1} + C, n \neq -1$$
$$\int \frac{du}{u} = \ln|u| + C$$
$$\int e^{ku} = \frac{e^{ku}}{k} + C$$
$$\int a^u du = \frac{1}{\ln a}a^u + C$$
$$\int \frac{1}{u}du = \ln|u| + C$$
$$\int \frac{du}{\sqrt{a^2 - u^2}} = sen^{-1}\frac{u}{a} + C$$
$$\int \frac{du}{a^2 + u^2} = \frac{1}{a}\tan^{-1}\frac{u}{a} + C$$
$$\int \frac{du}{u\sqrt{u^2 - a^2}} = \frac{1}{a}\sec^{-1}\frac{u}{a} + C$$
$$\int \frac{du}{a^2 - u^2} = \frac{1}{2a}\ln\left|\frac{u+a}{u-a}\right| + C$$
$$\int \frac{du}{u^2 - a^2} = \frac{1}{2a}\ln\left|\frac{u-a}{u+a}\right| + C$$

Integrales Trascendentes en "x"

$$\int \frac{1}{x}dx = \ln|x| + C$$
$$\int \frac{dx}{x\ln a} = \log_a x + C$$
$$\int a^x dx = \frac{a^x}{\ln a} + C$$
$$\int e^x dx = e^x + C$$

Integrales de Funciones Trigonométricas Inversas

$$\int sen^{-1} u du = u sen^{-1} u + \sqrt{1-u^2} + C$$
$$\int \cos^{-1} u du = u\cos^{-1} u - \sqrt{1-u^2} + C$$
$$\int \tan^{-1} u du = u\tan^{-1} u - \frac{1}{2}\ln\left(1+u^2\right) + C$$
$$\int \sec^{-1} u du = u\sec^{-1} u - \ln|u| + \sqrt{u^2+1} + C$$
$$\int \csc^{-1} u du = u\csc^{-1} u - \ln\left|u + \sqrt{u^2-1}\right| + C$$
$$\int \cot^{-1} u du = u\cot^{-1} u + \frac{1}{2}\ln\left(1+u^2\right) + C$$

Integrales de Funciones Hiperbólicas

Hiperbólicas Inversas:

$$\int \frac{du}{\sqrt{u^2 \pm a^2}} = \ln\left(u + \sqrt{u^2 \pm a^2}\right) + C$$
$$\int \frac{du}{u\sqrt{a^2 \pm u^2}} = -\frac{1}{a}\ln\left[\frac{a + \sqrt{a^2 \pm u^2}}{(u)}\right] + C$$
$$\int \frac{du}{a^2 - u^2} = \frac{1}{2a}\ln\left|\frac{a+u}{a-u}\right| + C$$