MAT 1050

Derivative Rules 1

	Function y	Derivative $\frac{dy}{dx}$
constant	c	0
x only	x	1
x to the power n	x^n	nx^{n-1}
Constant times function	$C.f(x)$	$C.f\,`(x)$
Adding	$f(x)+g(x)$	$f`(x)+g`(x)$
Subtracting	$f(x)-g(x)$	$f`(x)-g`(x)$
Square root	$\sqrt{x}$	$\frac{1}{2\sqrt{x}}$
One over x	$\frac{1}{x}$	$\frac{-1}{x^2}$
Product	$f(x).g(x)$	$f(x).g`(x)+g(x)f`(x)$
Quotient	$\frac{f(x)}{g(x)}$	$\frac{g(x).f\,`(x)-f(x).g`(x)}{[g(x)]^2}$
Trigonometric Functions	$sinx$	$cosx$
	$cosx$	$-sinx$
	$tanx$	sec^2x
	$secx$	$secx\,.tanx$
	$cscx$	$-cscx.cotx$
	$cotx$	$-csc^2x$
Chain Rule : $If\ y=f(u),\ u=g(x)\ then\ \frac{dy}{dx}=\frac{dy}{du}.\frac{du}{dx}$	$f(g(x))$	$f\,`\big(g(x)\big).g`(x)$
	$[f(x)]^n$	$n[f(x)]^{n-1}.f\,`(x)$
	$\sqrt{f(x)}$	$\frac{f\,`(x)}{2\sqrt{f(x)}}$
	$\frac{c}{f(x)}$	$\frac{-c.f\,`(x)}{[f(x)]^2}$
General Trigonometric Functions	$sinu$	$cosu\,.u`$
	$cosu$	$-sinu\,.u`$
	$tanu$	$sec^2u\,.u`$
	$secu$	$secu\ tanu\,.u`$
	$cscu$	$-cscu\ cotu\,.u`$
	$cotu$	$-csc^2u\,.u`$

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Derivative Rules 2

	Function y	Derivative $\frac{dy}{dx}$
Logarithmic Functions	$\ln x$	$\frac{1}{x}$
	$log_b\, x$	$\frac{1}{x.\, ln\, b}$
	$ln\, u$	$\frac{u`}{u}$
	$log_b\, u$	$\frac{u`}{u.\, lnb}$
Exponential Functions	e^x	e^x
	b^x	$b^x.\, ln\, b$
	e^u	$e^u\, .u`$
	b^u	$b^u\, .u`.\, ln\, b$
Inverse Trigonometric Functions	$sin^{-1}\, u$	$\frac{\mathbf{1}}{\sqrt{\mathbf{1-u^2}}}.u`$
	$cos^{-1}\, u$	$\frac{\mathbf{-1}}{\sqrt{\mathbf{1-u^2}}}.u`$
	$tan^{-1}\, u$	$\frac{\mathbf{1}}{\mathbf{1+u^2}}.u`$
	$cot^{-1}\, u$	$\frac{\mathbf{-1}}{\mathbf{1+u^2}}.u`$
	$sec^{-1}\, u$	$\frac{\mathbf{1}}{\mathbf{\lvert u\rvert}\sqrt{\mathbf{u^2-1}}}.u`$
	$csc^{-1}\, u$	$\frac{\mathbf{-1}}{\mathbf{\lvert u\rvert}\sqrt{\mathbf{u^2-1}}}.u`$

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Derivative Rules 3

	Function y	Derivative $\frac{dy}{dx}$
Hyperbolic Functions	$\sinh u$	$\cosh u.u`$
	$\cosh u$	$\sinh u.u`$
	$\tanh u$	$\operatorname{sech}^2 u.u`$
	$\coth u$	$-\operatorname{csch}^2 u.u`$
	$\operatorname{sech} u$	$-\operatorname{sec} h\, u\,.\tanh u.u`$
	$\operatorname{csch} u$	$-\operatorname{csch} u.\coth u.u`$
Inverse Hyperbolic Functions	$\sinh^{-1} u$	$\frac{\mathbf{1}}{\sqrt{\mathbf{1}+\boldsymbol{u}^{\mathbf{2}}}}.u`$
	$\cosh^{-1} u$	$\frac{\mathbf{1}}{\sqrt{\boldsymbol{u}^{\mathbf{2}}-\mathbf{1}}}.u`$
	$\tanh^{-1} u$	$\frac{\mathbf{1}}{\mathbf{1}-\boldsymbol{u}^{\mathbf{2}}}.u`$
	$\coth^{-1} u$	$\frac{\mathbf{1}}{\mathbf{1}-\boldsymbol{u}^{\mathbf{2}}}.u`$
	$\operatorname{sech}^{-1} u$	$\frac{-\mathbf{1}}{\boldsymbol{u}\sqrt{\mathbf{1}-\boldsymbol{u}^{\mathbf{2}}}}.u`$
	$\operatorname{csch}^{-1} u$	$\frac{-\mathbf{1}}{\lvert\boldsymbol{u}\rvert\sqrt{\mathbf{1}+\boldsymbol{u}^{\mathbf{2}}}}\,u`$

$$\sinh^{-1} x = \ln(x+\sqrt{x^2+1}) \qquad \cosh^{-1} x = \ln(x+\sqrt{x^2-1})$$

$$\tanh^{-1} x = \frac{1}{2}\ln\left(\frac{1+x}{1-x}\right) \qquad \coth^{-1} x = \frac{1}{2}\ln\left(\frac{x+1}{x-1}\right)$$

$$\operatorname{sech}^{-1} x = \ln\left(\frac{1+\sqrt{1-x^2}}{x}\right) \qquad \operatorname{csch}^{-1} x = \ln\left(\frac{1}{x}+\frac{\sqrt{1+x^2}}{|x|}\right)$$

Youtube Channel :

https://www.youtube.com/watch?v=yVJu0wySZ34&list=PL5bhcU_LmHLp_4dC1kkFHfu2MPOrR9HNF

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Trigonometric Identities :

$$sec x = \frac{1}{cos x} \quad , \quad csc x = \frac{1}{sin x} \quad ,$$

$$tan\, x = \frac{sin\, x}{cos\, x} \quad , cot x = \frac{cos\, x}{sin x} = \frac{1}{tan x}$$

$$Sin^2 x + cos^2 x = 1 \;, \quad \Longrightarrow \quad Sin^2 x = 1 - cos^2 x \;,$$

$$cos^2 x = 1 - sin^2 x$$

$$tan^2 x + 1 = sec^2 x \quad , \Longrightarrow \quad tan^2 x = sec^2 x - 1$$

$$1 + cot^2 x = csc^2 x \quad , \Longrightarrow \quad cot^2 x = csc^2 x - 1$$

$$sin\, 2x = 2\, sin\, x\, cos\, x$$

$$cos\, 2x = cos^2 x - sin^2 x$$

$$= 2\, cos^2 x - 1 \quad , \Longrightarrow \quad cos^2 x = \frac{1}{2}(1 + cos\, 2x)$$

$$= 1 - 2 sin^2 x \quad , \Longrightarrow \quad sin^2 x = \frac{1}{2}(1 - cos\, 2x)$$

Hyperbolic Functions

$$sinh\, x = \frac{e^x - e^{-x}}{2}$$

$$cosh\, x = \frac{e^x + e^{-x}}{2}$$

$$tanh\, x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

$$coth\, x = \frac{e^x + e^{-x}}{e^x - e^{-x}}$$

$$sech\, x = \frac{2}{e^x + e^{-x}}$$

$$csch\, x = \frac{2}{e^x - e^{-x}}$$

Logarithmic Properties

$$ln(x.y) = ln\, x + ln y$$

$$ln\left(\frac{x}{y}\right) = ln x - ln y$$

$$ln\, x^b = b.ln\, x$$

Hyperbolic Identities

$$cosh x + sinh\, x = e^x$$

$$cosh x - sinh\, x = e^{-x}$$

$$cosh^2 x - sinh^2 x = 1$$

$$1 - tanh^2 x = sech^2 x$$

$$coth^2 x - 1 = csch^2 x$$

$$sinh\, 2x = 2\, sinh\, x\, cosh\, x$$

$$cosh\, 2x = cosh^2 x + sinh^2 x$$

$$= 2\, cosh^2 x - 1$$

$$= 2 sinh^2 x + 1$$

$$sinh(-x) = -sinh\, x$$

$$cosh(-x) = cosh\, x$$

$$\sinh(x \pm y) = sinh x\, cosh y \pm cosh x\, sinh y$$

$$\cosh(x \pm y) = cosh x\, cosh y \pm sinh x\, sinh y$$

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