

CONTINUITY & DIFFERENTIABILITY

- * $[x] \rightarrow$ check disc at x
- * $\{x\} \rightarrow$ check disc at x
- * $\text{sgn}(x) \rightarrow$ check disc at $x=0$
- * $f(x)$ is a continuous function is $[a, b]$, then there exists atleast one 'c' such that $f(c) = x_0$, where $c \in [a, b] \in x_0 = [f(a), f(b)]$.
provided $f(a) \neq f(b)$.

Diff/

- * $f'(a) = \lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a} = L \rightarrow$ existence of non-vertical tgt.
- * $|x-a| \rightarrow$ not diff at $x=a$
- * $(x-a)|x-a| \rightarrow$ diff at $x=a$
- * If $f(x)$ is diff at $x=a$, $f'(x)$ need not be cont at $x=a$

DIFFERENTIATION

$f(x)$	$f'(x)$	$f(x)$	$f'(x)$
$\sin x$	$\cos x$	x^n	$n \cdot x^{n-1}$
$\cos x$	$-\sin x$	$\log x$	$\frac{1}{x}$
$\tan x$	$\sec^2 x$	a^x	$a^x \log_e a$
$\sec x$	$\sec x \cdot \tan x$		
$\csc x$	$-\csc x \cdot \cot x$		
$\cot x$	$-\csc^2 x$		
$\sin^{-1} x$	$\frac{1}{\sqrt{1-x^2}}$	$\csc^{-1} x$	$\frac{-1}{ x \sqrt{x^2-1}}$
$\cos^{-1} x$	$\frac{-1}{\sqrt{1-x^2}}$	$\sec^{-1} x$	$\frac{1}{ x \sqrt{x^2-1}}$
$\tan^{-1} x$	$\frac{1}{1+x^2}$	$\cot^{-1} x$	$\frac{-1}{1+x^2}$

$$*) \frac{dy}{dx} \left(\frac{u}{v} \right) = \frac{u'v - v'u}{v^2}$$

$$*) \text{ If } f(x) = \frac{g_1(x) \dots g_n(x)}{h_1(x) \dots h_m(x)} \quad (n) \cdot f(x) \dots \dots$$

$\rightarrow$ take log & diff

$$*) f(x)^{g(x)} = e^{g(x) \cdot \log f(x)}$$

$$*) (x^x)' = x^x [1 + \ln x]$$

*) For inverse functions $f(x), g(x)$ $f \circ g(x) = x$

$$f'(g(x)) \cdot g'(x) = 1$$

*) For implicit functions,

$$\frac{dy}{dx} = \frac{-F_x}{F_y} \rightarrow \text{wrt } x \left(\frac{\partial}{\partial x} \right)$$

$$\rightarrow \text{wrt } y \left(\frac{\partial}{\partial y} \right)$$

$$*) \frac{dx}{dy} = \frac{1}{(dy/dx)}$$

$$*) \frac{d^2x}{dy^2} = \frac{-y''}{(dy/dx)^3}$$