9.DIFFERENTIATION

(2 x 2) + (1 x 4) + (1 x 7) = 15 Marks

1. Derivative of $f(x)$ using First principles $f'(x) = \underset{h\to 0}{Lt}\dfrac{f(x+h)-f(x)}{h}$; $f'(a) = \underset{x\to a}{Lt}\dfrac{f(x)-f(a)}{x-a}$

2. If u, v are functions of x then $\dfrac{d}{dx}(uv) = u\dfrac{dv}{dx}+v\dfrac{du}{dx}$; $\dfrac{d}{dx}\left(\dfrac{u}{v}\right) = \dfrac{v\dfrac{du}{dx}-u\dfrac{dv}{dx}}{v^2}$

3. Chain Rule : $y = f(u), u = g(x) \Rightarrow \dfrac{dy}{dx} = \dfrac{dy}{du}.\dfrac{du}{dx}$ i.e., $y = f(g(x)) \Rightarrow \dfrac{dy}{dx} = f'(g(x)).g'(x)$

4. Derivatives of some standard & useful functions:

$$\frac{d}{dx}x^n = nx^{n-1};\ \frac{d}{dx}(k)=0;\ \frac{d}{dx}(kx)=k;\ \frac{d}{dx}kx^2 = 2kx;\ \frac{d}{dx}kx^3 = 3kx^2;\ \frac{d}{dx}\sqrt{x} = \frac{1}{2\sqrt{x}}$$

$$\frac{d}{dx}\frac{1}{x^n} = \frac{-n}{x^{n+1}};\quad \frac{d}{dx}\left(\frac{1}{x}\right) = \frac{-1}{x^2},\quad \frac{d}{dx}\frac{1}{\sqrt{x}} = \frac{-1}{2x\sqrt{x}}$$

$$\frac{d}{dx}(ax+b) = a;\ \frac{d}{dx}(ax+b)^2 = 2(ax+b)(a);\ \frac{d}{dx}\sqrt{ax+b} = \frac{a}{2\sqrt{ax+b}}$$

$$\frac{d}{dx}\log x = \frac{1}{x};\ \frac{d}{dx}\log_a x = \frac{1}{x}\log_a e;\ \frac{d}{dx}\log f(x) = \frac{1}{f(x)}.f'(x)$$

$$\frac{d}{dx}e^x = e^x;\ \frac{d}{dx}e^{f(x)} = e^{f(x)}f'(x);\ \frac{d}{dx}a^x = a^x\log_e a;\ \frac{d}{dx}x^x = x^x(1+\log x)$$

Trigonometric	Hyperbolic	Inverse Trigonometric	Inverse Hyperbolic
1. $\frac{d}{dx}\sin x = \cos x$	$\frac{d}{dx}\sinh x = \cosh x$	$\frac{d}{dx}\mathrm{Sin}^{-1}x = \frac{1}{\sqrt{1-x^2}}$	$\frac{d}{dx}\mathrm{Sinh}^{-1}x = \frac{1}{\sqrt{1+x^2}}$
2. $\frac{d}{dx}\cos x = -\sin x$	$\frac{d}{dx}\cosh x = \sinh x$	$\frac{d}{dx}\mathrm{Cos}^{-1}x = \frac{-1}{\sqrt{1-x^2}}$	$\frac{d}{dx}\mathrm{Cosh}^{-1}x = \frac{1}{\sqrt{x^2-1}}$
3. $\frac{d}{dx}\tan x = \sec^2 x$	$\frac{d}{dx}\tanh x = \mathrm{sech}^2 x$	$\frac{d}{dx}\mathrm{Tan}^{-1}x = \frac{1}{1+x^2}$	$\frac{d}{dx}\mathrm{Tanh}^{-1}x = \frac{1}{1-x^2}$
4. $\frac{d}{dx}\cot x = -\csc^2 x$	$\frac{d}{dx}\coth x = -\mathrm{csch}^2 x$	$\frac{d}{dx}\mathrm{Cot}^{-1}x = \frac{-1}{1+x^2}$	$\frac{d}{dx}\mathrm{Coth}^{-1}x = \frac{1}{1-x^2}$
5. $\frac{d}{dx}\sec x = \sec x\tan x$;	$\frac{d}{dx}\mathrm{sech}x = -\mathrm{sech}x\tanh x$;	$\frac{d}{dx}\mathrm{Sec}^{-1}x = \frac{1}{\lvert x\rvert\sqrt{x^2-1}}$	$\frac{d}{dx}\mathrm{Sech}^{-1}x = \frac{-1}{\lvert x\rvert\sqrt{1-x^2}}$
6. $\frac{d}{dx}\csc x = -\csc x\cot x$;	$\frac{d}{dx}\mathrm{csch}x = -\mathrm{csch}x\coth x$;	$\frac{d}{dx}\csc^{-1}x = \frac{-1}{\lvert x\rvert\sqrt{x^2-1}}$	$\frac{d}{dx}\mathrm{Csch}^{-1}x = \frac{-1}{\lvert x\rvert\sqrt{1+x^2}}$

5. Logarithmic Differentiaton: If $y=f(x)^{g(x)}$ then $\log y=g(x)\log f(x) \Rightarrow \dfrac{1}{y}\dfrac{dy}{dx}=g(x)\dfrac{1}{f(x)}f'(x)+\log f(x)g'(x)$

6. Derivative of a function w.r.t another function: If $y = f(x), z = g(x)$ then $\dfrac{dy}{dz} = \dfrac{df}{dg} = \dfrac{f'(x)}{g'(x)}$

7. Parametric differentiation: If $x = f(t), y = g(t)$ then $\dfrac{dy}{dx} = \dfrac{g'(t)}{f'(t)}$ and $\dfrac{d^2y}{dx^2} = \left[\dfrac{d}{dt}\left(\dfrac{dy}{dx}\right)\right]\left(\dfrac{dt}{dx}\right)$

BULLET MASTER'S

MATH BEATS!

DIFFERENTIATION in Calculus Vs STRAIGHT LINES in Geometry

IPE Weightage for Differentiation (2 + 4 + 7 = 15 Marks)

IPE Weightage for Straight Lines (2 + 4 + 7 = 15 Marks)

Straight Lines లో Slope లాంటిదే Differentiation లో Derivative.

Derivative అంటే Slope Formula వంటిదే అనే Secret కొద్ది మందికే తెలుసు!

Ex : $y = 2x + 3$; Slope $m = 2$ and Derivative $dy/dx = 2$

So, Straight Lines లో Line Equations కి Slope కట్టడం వంటిదే...

Derivatives లో Curve Equations కి Derivative కట్టడం!

Straight Lines లో Line కి Slope ను findout చేశాక Line Equation $y - y_1 = m(x - x_1)$

Derivatives లో Tangent కి Slope ను findout చేశాక Tangent equation $y - y_1 = m(x - x_1)$

Straight Lines లో Line కి Slope ను findout చేశాక Perpendicular Line equation $y - y_1 = -1/m(x - x_1)$

Derivatives లో Tangent కి Slope findout చేశాక Normal equation $y - y_1 = -1/m(x - x_1)$