ATOMIC ENERGY EDUCATION SOCIETY, MUMBAI

CLASS: XII(MATHS) **HANDOUT: MODULE 3/4**

CHAPTER-5 **TOPIC: CONTINUITY AND DIFFERENTIABILITY**

1) PROPERTIES OF LOGARITHMS

- $\log_a mn = \log_a m + \log_a n$
- $\log_a \left(\frac{m}{n}\right) = \log_a m - \log_a n$
- $\log_a m^n = n \log_a m$
- $\log_a m = \frac{\log_b m}{\log_b a}$

Some Standard Derivatives

(i) $\frac{d}{dx}(\sin x) = \cos x$

(ii) $\frac{d}{dx}(\cos x) = -\sin x$

(iii) $\frac{d}{dx}(\tan x) = \sec^2 x$

(iv) $\frac{d}{dx}(\sec x) = \sec x \tan x$

(v) $\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cot x$

(vi) $\frac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$

(vii) $\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$

(viii) $\frac{d}{dx}(\cos^{-1} x) = \frac{-1}{\sqrt{1-x^2}}$

(ix) $\frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2}$

(x) $\frac{d}{dx}(\sec^{-1} x) = \frac{1}{x\sqrt{x^2-1}}$

(xi) $\frac{d}{dx}(\operatorname{cosec}^{-1} x) = \frac{-1}{x\sqrt{x^2-1}}$

(xii) $\frac{d}{dx}(\cot^{-1} x) = \frac{-1}{1+x^2}$

(xiii) $\frac{d}{dx}(x^n) = nx^{n-1}$

(xiv) $\frac{d}{dx}(\text{constant}) = 0$

(xv) $\frac{d}{dx}(e^x) = e^x$

(xvi) $\frac{d}{dx}(\log_e x) = \frac{1}{x}, x > 0$

(xvii) $\frac{d}{dx}(a^x) = a^x \log_e a, a > 0$

2) LOGARITHMIC DIFFERENTIATION

If the given function is a $(function)^{function}$ or product or quotient of many functions we use logarithmic differentiation.

Let y = $f(x)^{\varphi(x)}$. Taking logarithm (with base e) on both sides

log y = log $f(x)^{\varphi(x)}$

logy = $\varphi(x) \log f(x)$. Differentiating both sides w.r.to x

$$\frac{d(logy)}{dx} = \frac{d(\varphi(x) \log f(x))}{dx}$$

$$\frac{1}{y}\frac{dy}{dx} = \varphi(x)\frac{1}{f(x)} f'(x) + logf(x)\, \varphi'(x)$$

$$\therefore \frac{dy}{dx} = y\left(\varphi(x)\frac{1}{f(x)} f'(x) + logf(x)\, \varphi'(x)\right)$$

Here f(x) and $\varphi(x)$ must always be positive as otherwise their logarithms are not defined

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