## Some Important Expansions.

In finding limits, use of expansions of following functions are useful:

$$(1)\,(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + .....$$

$$(2)\,a^x = 1 + x\log a + \frac{(x\log a)^2}{2!} + .....$$

$$(3)\,e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + .....$$

$$(4)\,\log(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + .....,\; |x| < 1$$

$$(5)\,\log(1-x) = -x - \frac{x^2}{2} - \frac{x^3}{3} - \frac{x^4}{4} - ....... \;,\quad \text{where } |x| < 1$$

$$(6)\,(1+x)^{\frac{1}{x}} = e^{\frac{1}{x}\log(1+x)} = e^{1-\frac{x}{2}+\frac{x^2}{3}}....... = e\left(1 - \frac{x}{2} + \frac{11}{24}x^2 - .......\right)$$

$$(7)\,\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - .......$$

$$(8)\,\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + ......$$

$$(9)\,\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + .....$$

$$(10)\,\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + .....$$

$$(11)\,\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + .....$$

$$(12)\,\tanh x = x - \frac{x^3}{3} + 2x^5 - .....$$

$$(13)\,\sin^{-1} x = x + 1^2.\frac{x^3}{3!} + 3^2.1^2.\frac{x^5}{5!} + .....$$

$$(14)\,\cos^{-1} x = \left(\frac{\pi}{2}\right) - \sin^{-1} x$$

(15) $\tan^{-1} x = x - \dfrac{x^3}{3} + \dfrac{x^5}{5} - \dfrac{x^7}{7} + \ldots$