

# ATOMIC ENERGY EDUCATION SOCIETY, MUMBAI

CLASS: XII(MATHS)

HANDOUT: MODULE 1/4

CHAPTER-5

TOPIC: CONTINUITY AND DIFFERENTIABILITY

## 1. CONTINUITY AT A POINT:

A function  $f(x)$  is said to be continuous at a point  $x = a$  if the Left hand limit of  $f(x)$  at  $(x = a) =$   
Right hand limit of  $f(x)$  at  $(x = a) =$  Value of  $f(x)$  at  $x = a$

i.e if  $f(x)$  is continuous at  $x = a$ ,  $LHL = RHL = f(a)$  where  $LHL = \lim_{x \rightarrow a^-} f(x)$ ,

$RHL = \lim_{x \rightarrow a^+} f(x)$

Note: To evaluate LHL of a function  $f(x)$  at  $x = a$ , put  $x = a - h$  and to find RHL, put  $x = a + h$

## 2. CONTINUITY IN AN INTERVAL:

A function  $y = f(x)$  is said to be continuous in an interval  $(a, b)$  if it is continuous at every point in that interval.

It is said to be continuous in  $[a, b]$  if it is continuous in  $(a, b)$  and  $\lim_{x \rightarrow a^+} f(x) = f(a)$

and  $\lim_{x \rightarrow b^-} f(x) = f(b)$

## 3. EXAMPLES OF SOME CONTINUOUS FUNCTIONS

- Every polynomial function is continuous
- Constant function is continuous
- Identity function is continuous
- Every rational function is continuous in its domain
- All trigonometric functions are continuous in their domain

## 4. STANDARD LIMITS:

$$1) \lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = na^{n-1} \quad 2) \lim_{x \rightarrow 0} \frac{\sin x}{x} = 1 \quad 3) \lim_{x \rightarrow 0} \frac{\tan x}{x} = 1 \quad 4) \lim_{x \rightarrow 0} \frac{e^x - 1}{x} = 1$$

$$5) \lim_{x \rightarrow 0} \frac{\log(1+x)}{x} = 1 \quad 6) \lim_{x \rightarrow 0} \frac{a^x - 1}{x} = \log a \quad 7) \lim_{x \rightarrow 0} (1+x)^{\frac{1}{x}} = e$$

## 5. ALGEBRA OF CONTINUOUS FUNCTIONS

Suppose  $f$  and  $g$  are two real functions continuous at  $x = a$ , a real number then

- $f + g$  is continuous at  $x = a$
- $f - g$  is continuous at  $x = a$
- $f \cdot g$  is continuous at  $x = a$
- $\frac{f}{g}$  is continuous at  $x = a$
- $kf$  is continuous at  $x = a$ , where  $k$  is a constant

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