Function and their Properties

Detailed Course 2.0 on Function of One and Several Variable - IIT JAM, 23

Gajendra Purohit • Lesson 1 • Nov 10, 2022

Gajendra Purohit

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Function of one variable

Function : A mapping $f : A \to B$ is said to be a function if every element of A assign to unique element of B.

Domain and range of function :

(i) Domain of function : Let $f : D \to R$ is a real value function then D is called domain of function

Another definition : Let $f : D \to R$ is a real valued function. Then the set of all points of R at which the function is well define then this set is called as domain of function.

(ii) Range of function : Let $f : A \to B$ is a function. then the set of all images of distinct elements of A is called range of function.

Bounded and Monotonic function :

(i)Bounded function : A function $f : D \to R$ is called bounded function if range of this function is bounded.

(ii) Monotonic function :

(1) Monotonic increasing function :

Let $f : D \to R$ be a function, then f is called monotonic increasing function is for

$x_1 < x_2 \Rightarrow f(x_1) \leq f(x_2)$; for all $x_1, x_2 \in D$

(2) Monotonic decreasing function :

A function $f : D \to R$ is called monotonic decreasing if for $x_1 < x_2 \Rightarrow f(x_1) \geq f(x_2)$ for all $x_1, x_2 \in D$

One-One function : A real valued function $f : D \to R$ is called one-one function if $x_1 \neq x_2 \Rightarrow f(x_1) \neq f(x_2)$

Conclusion :

(1) If function is non-monotonic then this function is not one-one function.

(2) If function is strictly monotonic then this function is one-one function.

Another trick for one-one function :

(1) If graph of function intersect each line which parallel to x-axis at atmost one point.

(2) If $f'(x) > 0$ or $f'(x) < 0$ i.e. $f(x)$ is strictly monotonic function then $f(x)$ is one – one

Q.1. Let $f : R \to R$ is one-one function, then which of the following is/are true?

(a) f(x) is strictly increasing function.

(b) f(x) is strictly decreasing function.

(c) f(x) is strictly monotonic function.

(d) f(x) is monotonic function.

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Onto Function : A function $f : A \to R$ is said to be onto if $f(A) = R$.

Note : A function which is onto or not onto it is totally depend on co-domain.

Check onto function by graph :

If graph of function intersect each line which parallel to x-axis and contain in co-domain, then this function is onto function.

Q.2. Ler $f : R \to R^+$ is a non-monotonic function, then which of the following is true?

(a) A function is always one-one.

(b) A function may be one-one.

(c) A function is always onto

(d) A function may be onto

Composition of Function :

Let $f : A \to B$ and $g : B \to C$ are two real valued function then gof(x) is composition of function, where $gof(x) = g[f(x)]$.

Result : If gof(x) is one-one and onto, then f(x) is one-one and g(x) is onto.

Q.3. Let $f : X \to X$ such that $f(f(x)) = x$ for all $x \in X$. Then

(a) f is one-to-one and onto.

(b) f is one-to-one, but not onto

(c) f is onto but not one-to-one

(d) f need not be either one-to-one or onto

Limit of function : Let f be a function defined for all points in some neighbourhood of a point a.

We say that f tends to the limit l as x tends to a.

i.e. $\lim_{x \to a} f(x) = l$

Then l is called limit of function.

Right hand limit : Let f(x) be a function, $\lim_{x \to a+0} f(x) = f(a+0) = l$ then is called right hand limit.

Left hand limit : Let f(x) be a function, then $\lim_{x \to a-0} f(x) = f(a-0) = l$ is called left hand limit of f(x) at 'a'.

Note : Let f(x) be a function then $\lim_{x \to a} f(x) = f(a+0) = f(a-0)$.

Q.4. Let $f : (-1,1) \to R$ and $g : (-1,1) \to R$ be thrice continuously differential function such that $f(x) \neq g(x)$ for every non – zero $x \in (-1,1)$. Suppose $f(0) = \log 2$, $f'(0) = \pi$, $f''(0) = \pi^2$, $f'''(0) = \pi^9$ and $g(0) = \log 2$, $g'(0) = \pi$, $g''(0) = \pi^2$, $g'''(0) = \pi^3$ then the value of limit $\lim_{x \to 0} \frac{e^{f(x)} - e^{g(x)}}{f(x) - g(x)}$ is **IIT JAM 2022**

(a) 1 (b) 2

(c) 3 (d)4

Q.5. Which of the following is false

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(a) $\lim_{x\to\infty}\frac{x}{e^x}=0$

(b) $\lim_{x\to 0^+}\frac{\sin x}{1+2x}=0$

(c) $\lim_{x\to 0^+}\frac{1}{xe^{\frac{1}{x}}}=0$

(d) $\lim_{x\to 0^+}\frac{\cos x}{1+2x}=0$

Q.6. The value of $\lim_{x \to 0} \frac{|x| - x}{2x}$ is

(a) 0 (b) 2

(c) 1 (d) does not exist

Q.7. The value of $\lim_{x \to 0} \frac{x}{\sqrt{1-\cos x}}$

(a) $\sqrt{2}$

(b) $-\sqrt{2}$

(c) $\frac{1}{\sqrt{2}}$

(d) $-\frac{1}{\sqrt{2}}$

Q.8. Let f be a monotone non-decreasing real-valued function on R. Then

(a) $\lim_{x \to a} f(x)$ exists at each point a.

(b) If a < b, then $\lim_{x \to a^+} f(x) \leq \lim_{x \to b^-} f(x)$.

(c) f is an unbounded function

(d) The function $g(x) = e^{-f(x)}$ is a bounded function.

Q.9. Let p be a real polynomial of the real variable x of the form $p(x) = x^n + a_{n-1}x^{n-1} + ... + a_1x + 1$. Suppose that p has no roots in the open unit disc and $p(-1) = 0$. Then

(a) $p(1) = 0$

(b) $\lim_{x\to\infty} p(x) = \infty$

(c) $p(2) > 0$

(d) $p(3) = 0$

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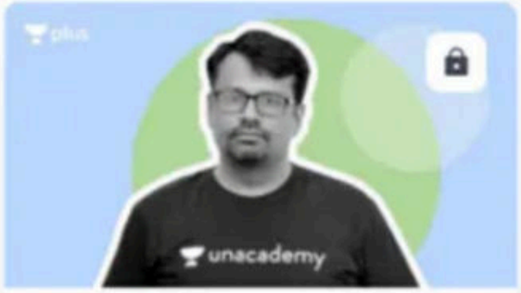

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Educator highlights

- Works at **Pacific Science College**
- Studied at **M.Sc., NET, PhD(Algebra), MBA(Finance), BEd**
- PhD, NET | Plus Educator For CSIR NET | Youtuber (260K+Subs.) | Director Pacific Science College |
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