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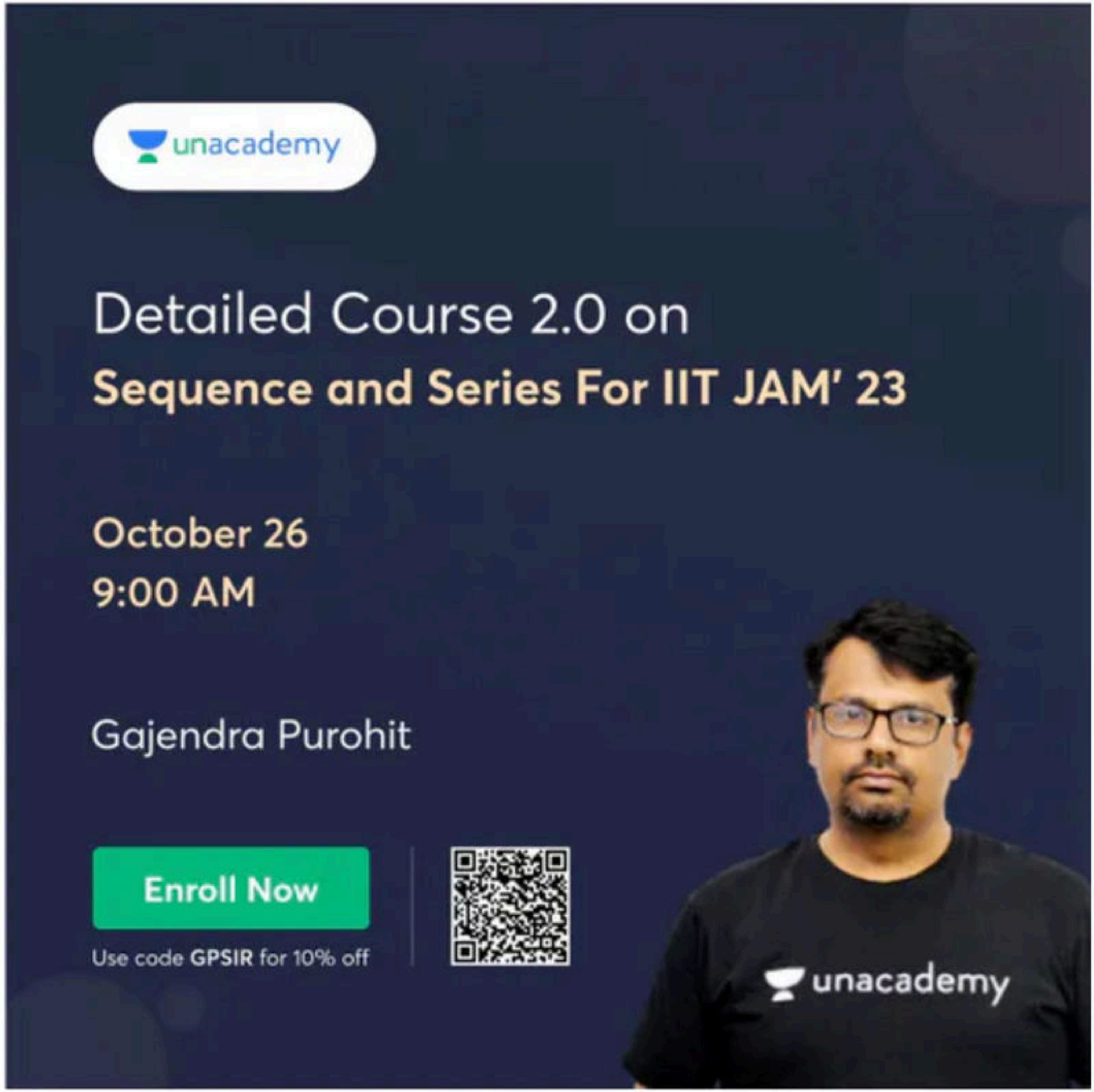
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Differentiability

Let f : [a, b] $\to$ R is a real valued function it is said to be a differentiable at x = c.

If $\lim\limits_{x \to c} \dfrac{f(x) - f(c)}{x - c}$ finitely exist.

Right Hand Derivative :

$$Rf`(c) = \lim_{h \to 0} \frac{f(c+h) - f(c)}{h}$$

Left Hand Derivative :

$$Rf`(c) = \lim_{h \to 0} \frac{f(c-h) - f(c)}{-h}$$

Note : If f(x) is differentiable at x = c

Iff $\quad Rf`(c) = Lf`(c)$

Q.1. Let $f(x)=\begin{cases}\dfrac{\sin x}{x} & if \quad x\neq 0\\ 1 & if \quad x=0\end{cases}$, then f is

(a) Discontinuous

(b) Continuous but not differentiable

(c) Differentiable only once

(d) Differentiable more than once.

Necessary condition for differentiable :

If a function is differentiable at $x = c$, then it is continuous at $x = c$ but converse may not be true.

Conclusion :

$$f(x)=\begin{cases} x^{\alpha}\sin\dfrac{1}{x^{\beta}}; & x\neq 0 \\ 0; & x=0 \end{cases}$$

(i) f(x) is continuous at x = 0 for $\alpha > 0$

(ii) f(x) is differentiable at x = 0 for $\alpha > 1$

Result :

(1) $$f(x)=\begin{cases} x^{\alpha}\sin\dfrac{1}{x^{\beta}}; & x\neq 0 \\ 0; & x=0 \end{cases}$$

then f(x) is differentiable $\left[\dfrac{p}{q}\right]$ times and

$$f^{\left[\frac{p}{q}\right]}=\begin{cases} \text{continuous} & \text{if } p \text{ is odd} \\ \text{discontinuous} & \text{if } p \text{ is even} \end{cases}$$

(2) Let f : R → R be defined by $f(x) = \begin{cases} \phi_1(x) & x \in Q \\ \phi_2(x) & x \in Q^c \end{cases}$

f(x) is differentiable at the double root of $\phi_1(x) - \phi_2(x) = 0$

(3) A function is not differentiable at that point at which graph of function is sharp edge.

Q.2. Consider the function $f(x) = |\cos x| + |\sin(2-x)|$.

At which of the following points is f not differentiable?

(a) $\left\{(2n+1)\dfrac{\pi}{2} : n \in Z\right\}$ (b) $\{n\pi : n \in Z\}$

(c) $\{n\pi + 2 : n \in Z\}$ (d) $\left\{\dfrac{n\pi}{2} : n \in Z\right\}$

Q.3. The function $f(x) = a_0 + a_1|x| + a_2|x|^2 + a_3|x|^3$ is differentiable at $x = 0$

(a) for no values of a_0, a_1, a_2, a_3

(b) for any value of a_0, a_1, a_2, a_3

(c) only if $a_1 = 0$

(d) only if both $a_1 = 0$ and $a_3 = 0$

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Q.4. Let $f : R \to R$ be a differentiable function with $f(0) = 0$. If for all $x \in R$, $1 < f'(x) < 2$, then which one of the following statements is true on $(0, \infty)$?

IIT JAM 2015

(a) f is unbounded

(b) f is increasing and bounded

(c) f has at least one zero

(d) f is periodic

Q.5. Let the function f : R → R as

$$f(x)=\begin{cases} x^2 & x\in(0,2)\cap Q \\ 2x-1 & x\in(0,2)\cap(R/Q) \end{cases},$$

Which one of the following is not true?

(a) f is continuous at x = 1

(b) f is differentiable at x = 1

(c) f is not differentiable at x = 1

(d) f is differentiable only at x = 1

Q.6. Let S be the set of all function $f : R \to R$ satisfying $|f(x) - f(y)|^2 \leq |x - y|^3$ for all x,y in R.Then which of the following is /are true **IIT JAM 2022**

(a) Every function in S is differentiable

(b) $\exists$ a function $f \in S$ s.t. f is twice differentiable but f is not thrice differentiable

(c) $\exists$ a function $f \in S$ s.t. f is differentiable but f is not twice differentiable

(d) f is infinitely differentiable

Q.7. Let f : R $\to$ R be such that f, f\` and f\`\` are all continuous functions with f > 0, f\` > 0 and f\`\`(0), then $\lim_{x\to-\infty} \frac{f(x)+f`(x)}{2}$ is? **IIT JAM 2020**

(a) 0 (b) 1

(c) 2 (d) 3

Q.8. Let f : [-1, 3] $\rightarrow$ R be a continuous function such that f differentiable on (-1, 3), $|f`(x)| \leq \frac{3}{2}$ for all x $\in$ (-1, 3), f(-1) = 1 and f(3) = 7 then f(1) = ? **IIT JAM 2020**

(a) 2 (b) 3

(c) 4 (d) 5

Q.9. Let $f : R \to R$ be a differentiate function such that $f'(x) > f(x)$, for all $x \in R$ and $f(0) = 1$, then $f(1)$ lies in the interval.

(a) $(0, e^{-1})$ (b) $(\sqrt{e}, e)$

(c) $(e^{-1}, \sqrt{e})$ (d) (e, ∞)

Q.10. Let f : [0 , 1] → R be a continouos function such that $f\left(\frac{1}{2}\right) = -\frac{1}{2}$ and $|f(x) - f(y) - (x - y)| \le \sin(|x - y|^2)$, ∀ x,y ∈ [0,1]. then $\int_0^1 f(x)dx$ **IIT JAM 2020**

(a) -1/2 (b) -1/4

(c) 1/4 (d) 1/2


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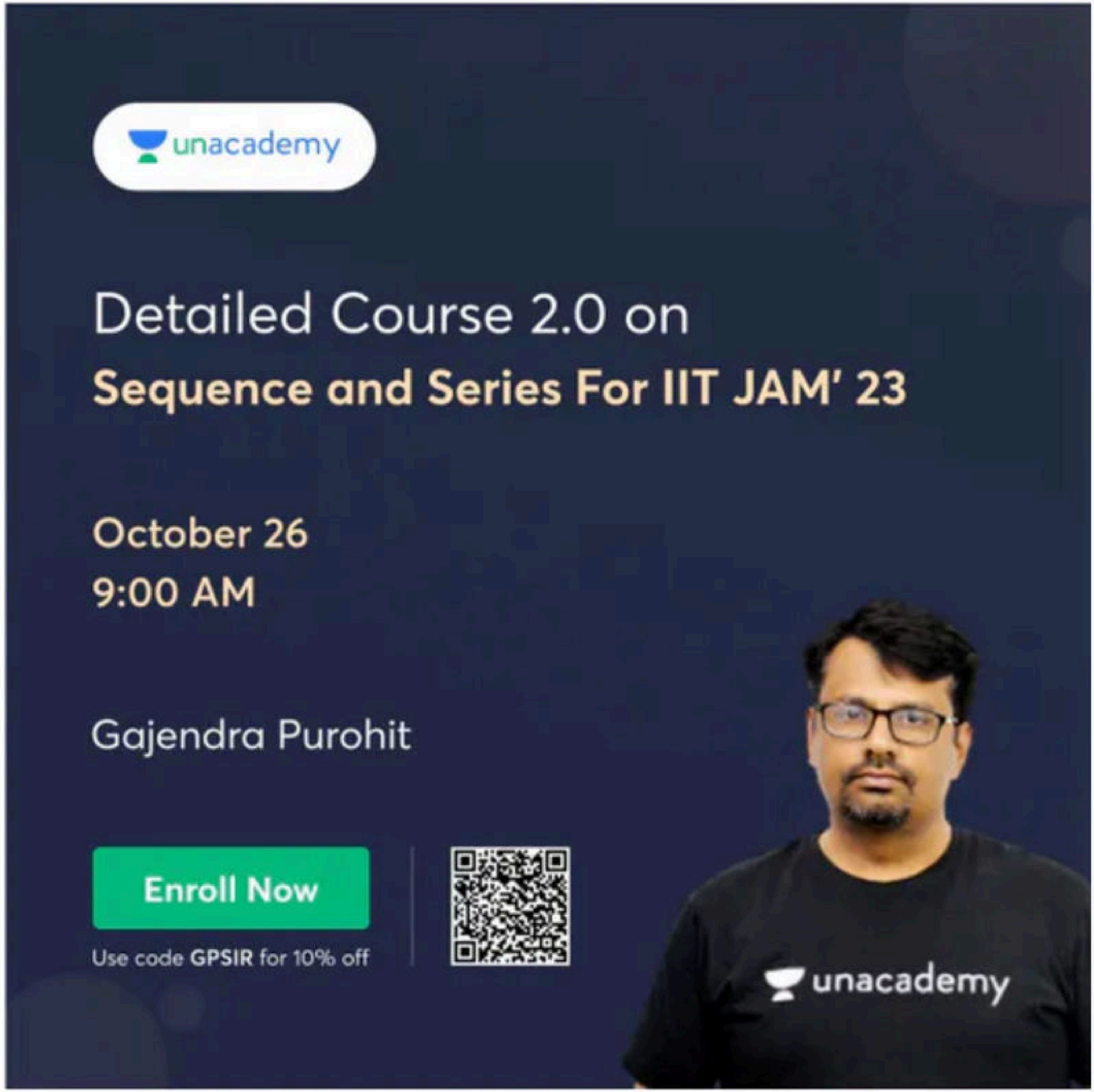
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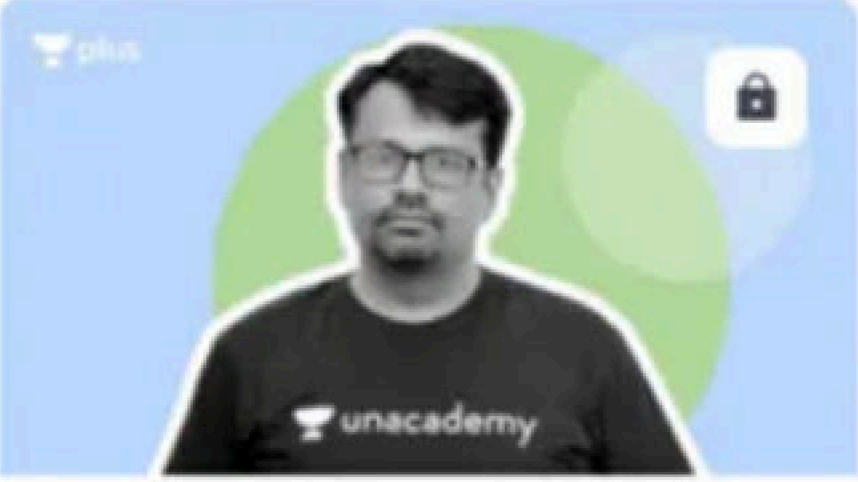

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Educator highlights

- 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 |
- Lives in **Udaipur, Rajasthan, India**
- Unacademy Educator since

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