Gajendra Purohit

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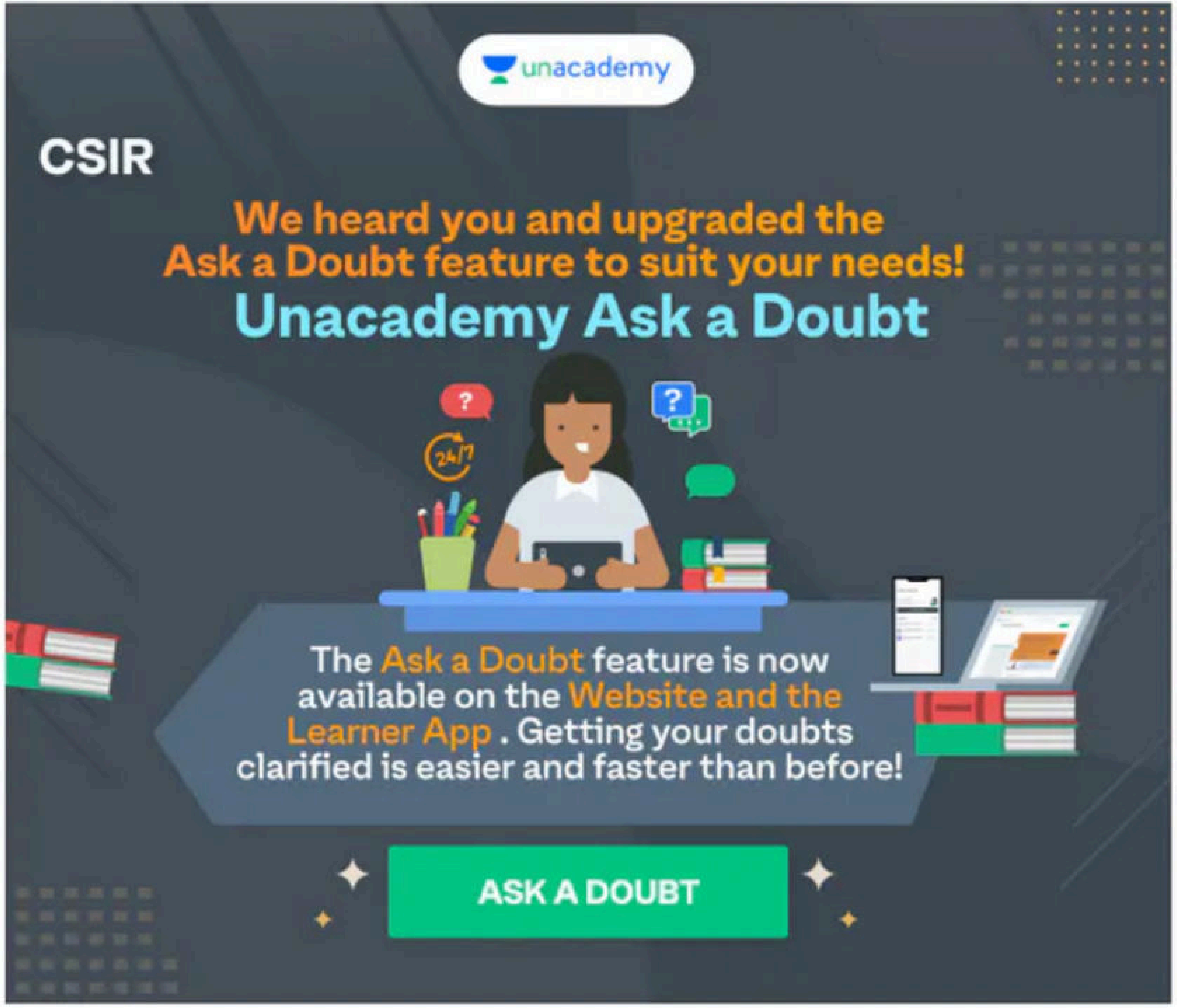
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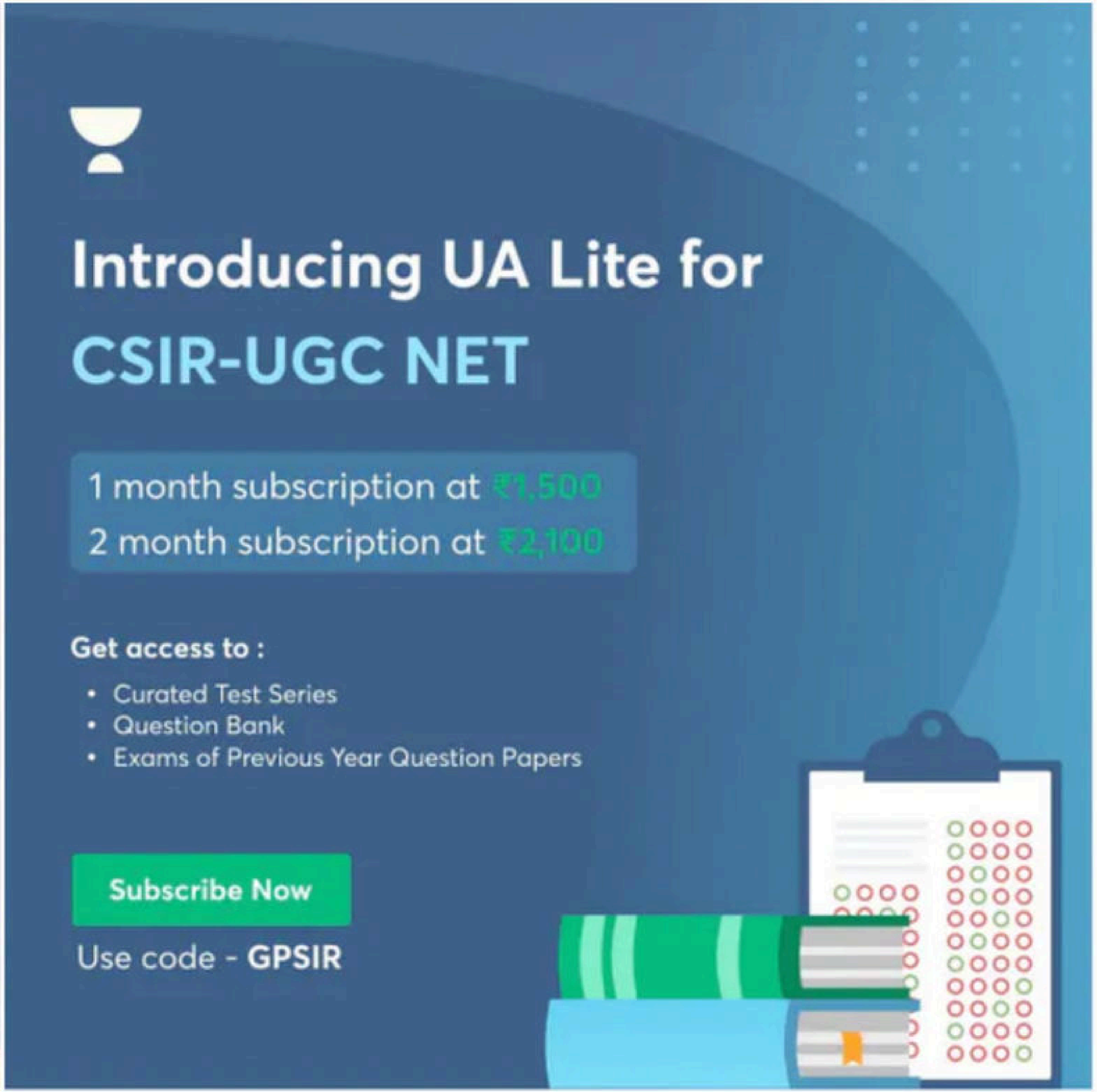
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5. The Wronskian :

Definition :The Wronskian of n functions $y_1(x)$, $y_2(x)$ ...... $y_n(x)$ is denoted by $w(x)$ or $w(y_1, y_2, \ldots, y_n)$

$$= \begin{vmatrix} y_1 & y_2 \ldots\ldots y_n \\ y'_1 & y_2' \ldots\ldots y'_n \\ \vdots & \\ y_1^{(n-1)} & y_2^{(n-1)} \ldots\ldots y_n^{(n-1)} \end{vmatrix}$$

Wronskian of second order DE

Let $a_0(x)\, y'' + a_1(x)\, y' + a_2(x)\, y = 0$

Where $a_0(x)$, $a_1(x)$, $a_2(x)$ are continuous and $a_0(x) \neq 0 \ \forall$ x

If $y_1(x)$ and $y_2(x)$ are solution

Then $w(y_1, y_2) = \begin{vmatrix} y_1 & y_2 \\ y_1' & y_2' \end{vmatrix} = y_1 y_2' - y_2 y_1'$

Able's Formula:

Let $a_0(x)\, y`` + a_1(x)\, y` + a_2(x)\, y = 0$

Where $a_0(x)$, $a_1(x)$, $a_2(x)$ are continuous and $a_0(x) \neq 0\ \forall$ x

$w(y_1, y_2) = Ae^{-\int \frac{a_1(x)}{a_0(x)} dx}$ is called Able's formula.

RESULTS:

(1) If $w(y_1, y_2, ...y_n) \neq 0$ then $y_1, y_2 ...... y_n$ are L.I. solution.

(2) If $w(y_1, y_2, ... y_n) = 0$ then $y_1, y_2, ...y_n$ are LD solution.

(3) Wronskian is either identically zero or non-zero.

(4) If Wronskian is non – zero at least one point then Wronskian is identically non – zero

(5) If Wronskian is zero at least one point then Wronskian is identically zero

(6) Wronskian can never change its sign

Q2. Consider two solution $x(t)=x_1(t)$ and $x(t)=x_2(t)$ of differential equation $\frac{d^2x(t)}{dt^2}+x(t)=0,\ t>0$ such that $x_1(0)=1, \left.\frac{dx_1(t)}{dt}\right|_{t=0}=0, x_2(0)=0, \left.\frac{dx_2(t)}{dt}\right|_{t=0}=1$ the Wronskian $W(t)=\begin{vmatrix} x_1(t) & x_2(t) \\ \frac{dx_1(t)}{dt} & \frac{dx_1(t)}{dt} \end{vmatrix}$ and at $t=\pi/2$ is

(a) 1 (b) – 1

(c) 0 (d) $\pi/2$

Q3. Let $y_1(x)$ and $y_2(x)$ be two linearly independent solution of the differential equation $x^2y''(x)-2xy'(x)-4y(x)=0$ for $x\in[1,10]$. Considered the wronskian $W(x)=y_1(x)y_2'(x)-y_2(x)y_1'(x)$. If $W(1)=1$, then $W(3)-W(2)$ equals

(a) 1 (b) 2

(c) 3 (d) 5

Q4. Let $y_1(x)$ and $y_2(x)$ be the linearly independent solutions of $xy''+2y'+xe^x y=0$ If $W(x)=y_1(x)y_2'(x)-y_2(x)y_1'(x)$ with W (1) = 2 find W (5)

(a) $\frac{2}{25}$

(b) $\frac{1}{25}$

(c) $\frac{2}{5}$

(d) None of the above

Q.5. Consider the ODE

$$u''(t)+P(t)u'(t)+Q(t)u(t)=R(t), t\in[0,1]$$

There exist continuous function P,Q and R defined on $[0,1]$ and two solutions u_1 and u_2 of the ODE such that the Wronskian W of u_1 and u_2 is

(a) $W(t)=2t-1, 0\le t\le 1$

(b) $W(t)=\sin 2\pi t, 0\le t\le 1$

(c) $W(t)=\cos 2\pi t, 0\le t\le 1$

(d) $W(t)=1, 0\le t\le 1$

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Q.6. Consider the ordinary DE $y'' + P(x)\, y' + Q(x)\, y = 0$, Where P and Q are smooth functions. Let y_1 and y_2 be any two solution of the ODE. Let $w(x)$ be the Wronskian. Then which of the following is always true.

(a) If y_1 & y_2 are LD then $\exists\ x_1, x_2$ s.t. $w(x_1) = 0$ and $w(x_2) \neq 0$

(b) If y_1 & y_2 are LI then $w(x) = 0\ \forall\ x$

(c) If y_1 & y_2 are LD then $w(x) \neq 0\ \forall\ x$

(d) If y_1 & y_2 are LI then $w(x) \neq 0\ \forall\ x$

Q.7. Let P,Q be continuous real valued functions defined on $[-1,1]$ and $u_i:[-1,1]\to R, i=1,2$ be solutions of the ODE: $\frac{d^2u}{dx^2}+P(x)\frac{du}{dx}+Q(x)d=0, x\in[-1,1]$ satisfying $u_1\geq 0, u_2\leq 0$ and $u_1(0)=u_2(0)=0$. Let w denote the Wronskian of u_1 and $u_{2,}$ then

(a) u_1 and $u_{2,}$ are linearly independent

(b) u_1 and $u_{2,}$ are linearly dependent

(c) $w(x)=0$ for all $x\in[-1,1]$

(d) $w(x)\neq 0$ for some $x\in[-1,1]$

Q.8. Let $Y_1(x)$ and $Y_2(x)$ defined on $[0,1]$ be twice continuously differentiable functions satisfying $Y''(x)+Y'(x)+Y(x)=0$. Let $W(x)$ be the Wronskian of Y_1 and Y_2 and satisfy $W\left(\frac{1}{2}\right)=0$. Then

(a) $W(x)=0$ for $x \in [0,1]$

(b) $W(x) \neq 0$ for $x \in [0,1/2) \cup (1/2,1]$

(c) $W(x) > 0$ for $x \in (1/2,1]$

(d) $W(x) < 0$ for $x \in [0,1/2)$

Q.9. Let $y_1(x)$ and $y_2(x)$ be two solutions of $(1-x^2)\frac{d^2y}{dx^2}-2x\frac{dy}{dx}+\sec x.y=0$ with Wronskian W(x).If $y_1(0)=1, \left(\frac{dy_1}{dx}\right)_{x=0}=0$ and $W\left(\frac{1}{2}\right)=\frac{1}{3}$, then $\left(\frac{dy_2}{dx}\right)_{x=0}$ equals

(a) 1/4 (b) 1

(c) 3/4 (d) 4/3

Q.10. Let $y = \phi(x)$ and $y = \psi(x)$ be solutions of $y'' - 2xy' + (\sin x^2)y = 0$ such that $\phi(0) = 1, \phi'(0) = 1$ and $\psi(0) = 1, \psi'(0) = 2$. Then the value of the Wronskian $W(\phi, \psi)$ at $x = 1$ is

(a) 0 (b) 1

(c) e (d) e^2

Q.11. Consider the ordinary DE $y'' + P(x)\, y' + Q(x)\, y = 0$

Where P and Q are smooth function. Let y1 and y2 be any two solution of the ODE. Let w(x) be the Wronskian. Then which of the following is always true.

(a) If y_1 & y_2 are LD then $\exists\, x_1, x_2$ s.t. $w(x_1)=0$ & $w(x_2) \neq 0$

(b) If y_1 & y_2 are LI then $w(x) = 0\ \forall\ x$

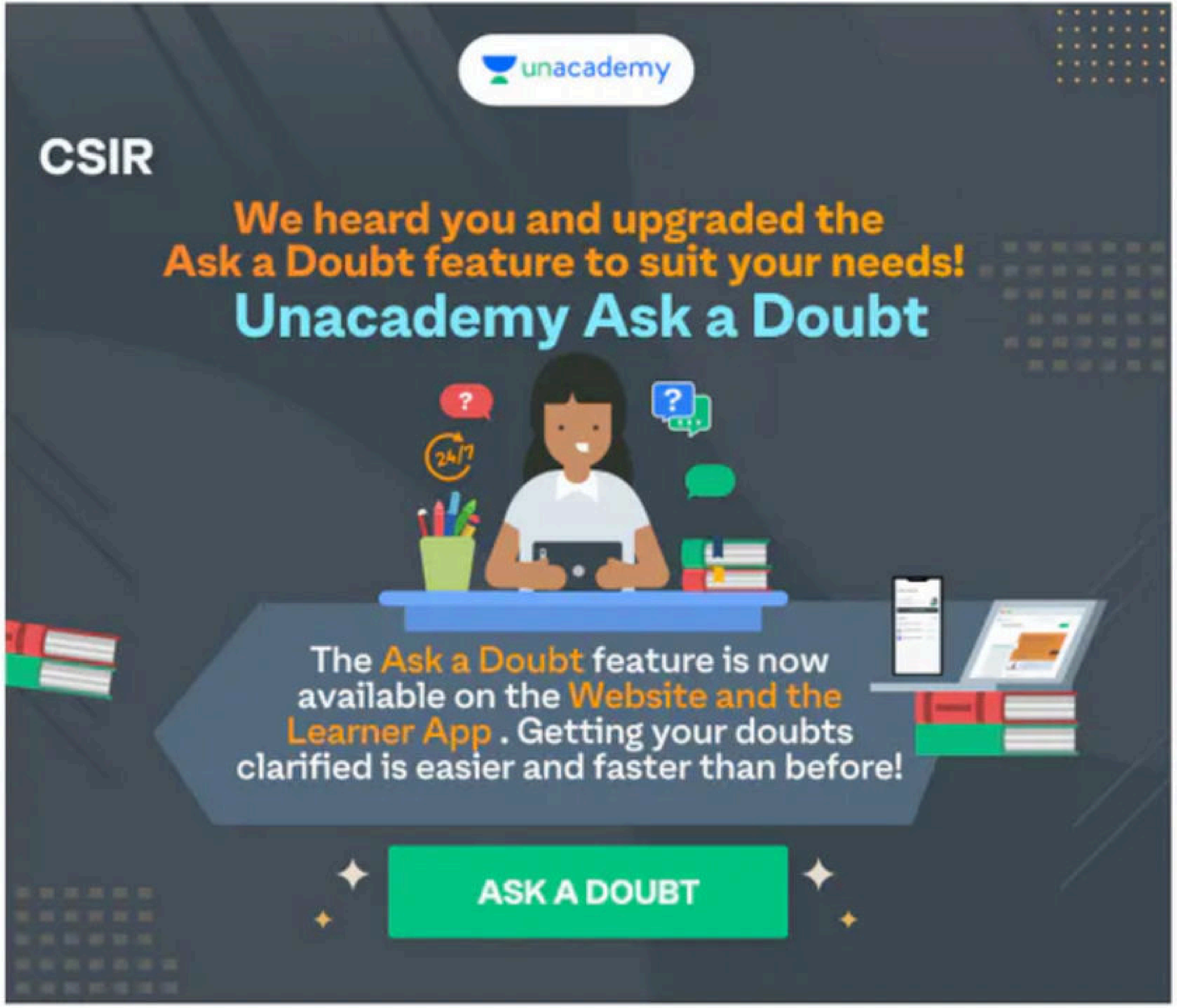
(c) If y_1 & y_2 are LD then $w(x) \neq 0\ \forall\ x$

(d) If y_1 & y_2 are LI then $w(x) \neq 0\ \forall\ x$

Q.12 The wronskian of two solutions of the differential equation $t^2y'' - t(t+2)y' + (t+2)y = 0$ satisfies $W(1) = 1$ is

(a) t^2e^t (b) t^2e^{t-1}

(c) $t\,e^t$ (d) $t\,e^{t-1}$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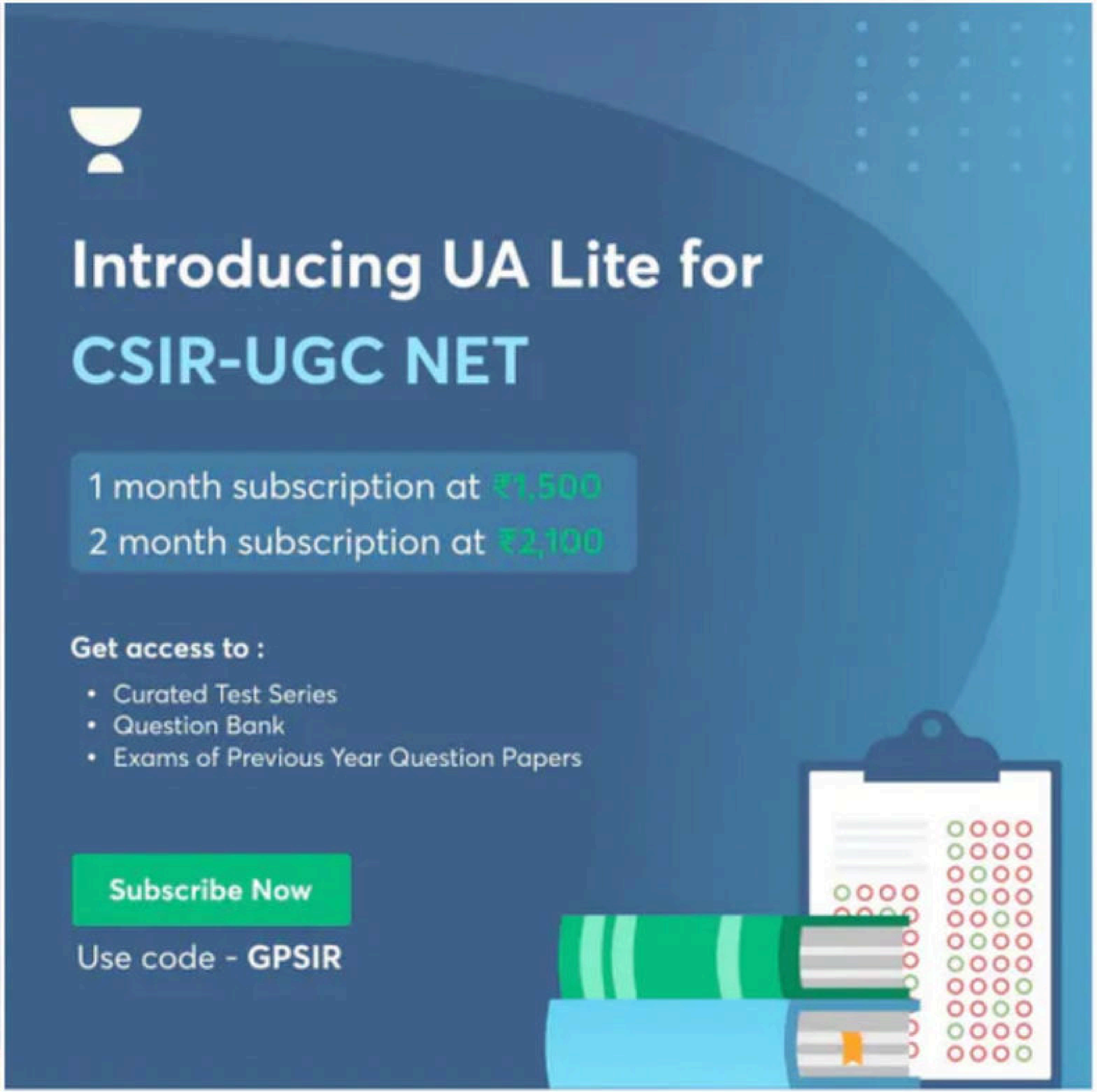
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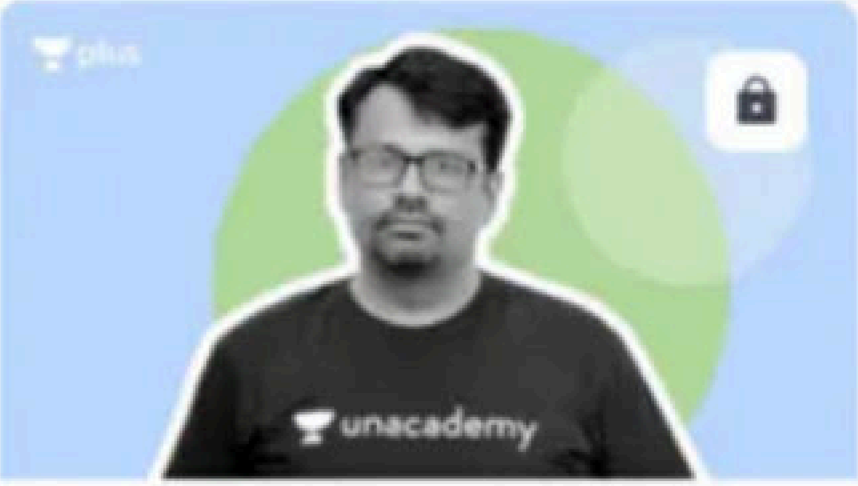

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- Studied at **M.Sc., NET, PhD(Algebra), MBA(Finance), BEd**
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- Lives in **Udaipur, Rajasthan, India**
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