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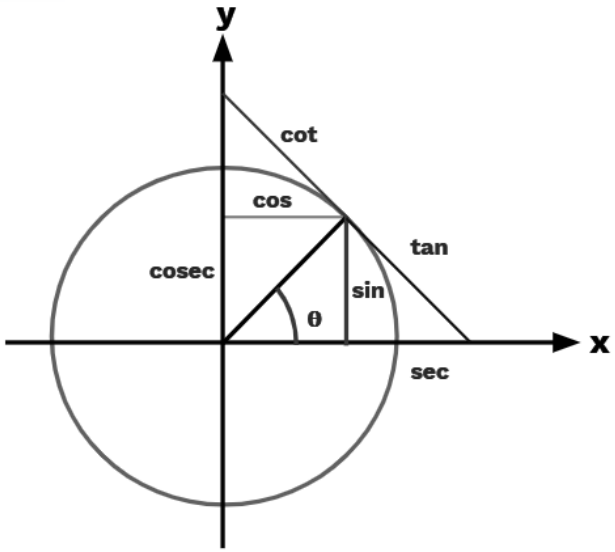
Trigonometric Equations

3



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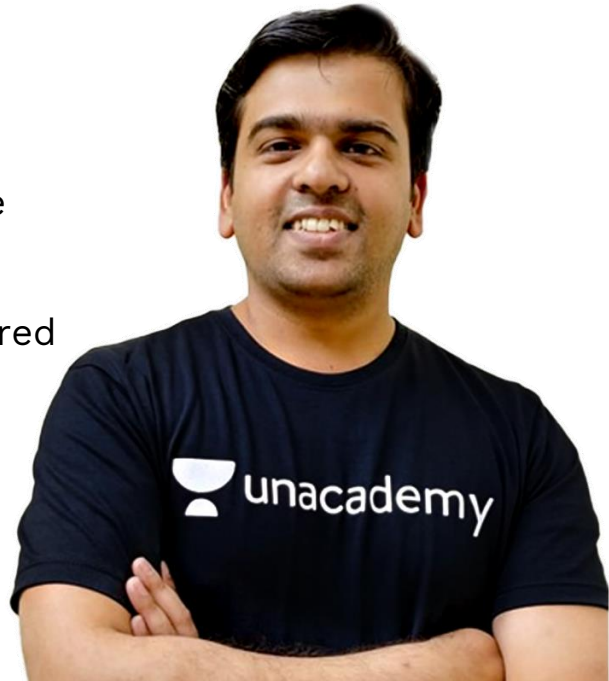
B.Tech, M.Tech - IIT-Roorkee

- **10+** years Teaching experience
- Taught **1 Million+** Students
- **100+** Aspiring Teachers Mentored



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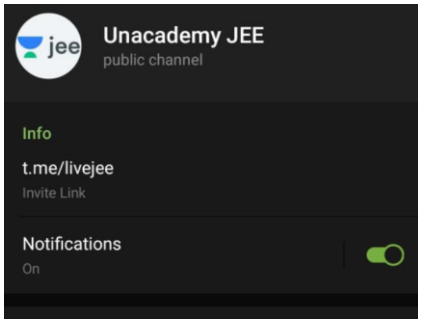

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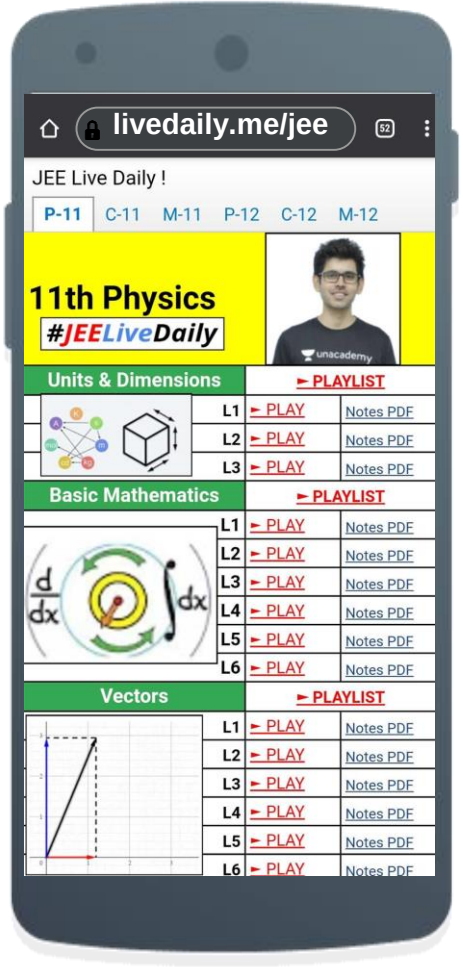

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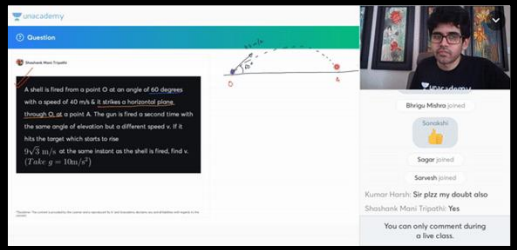

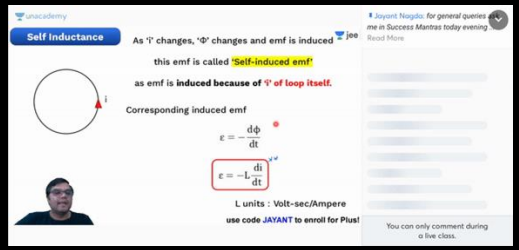

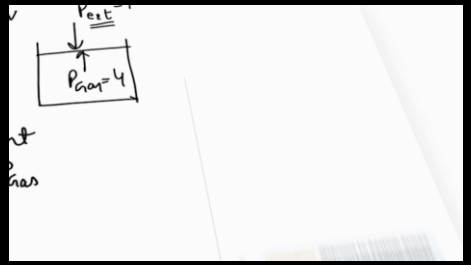

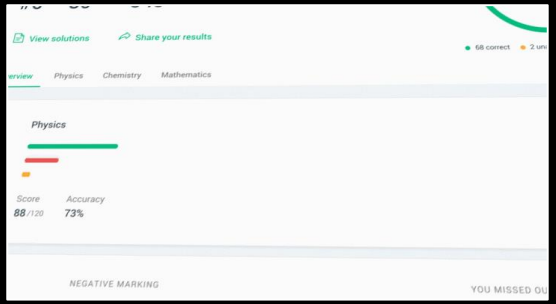

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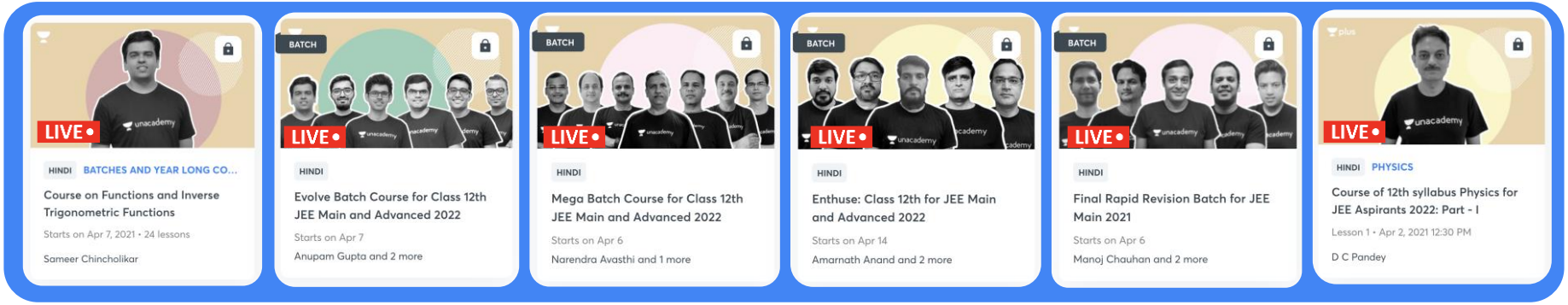

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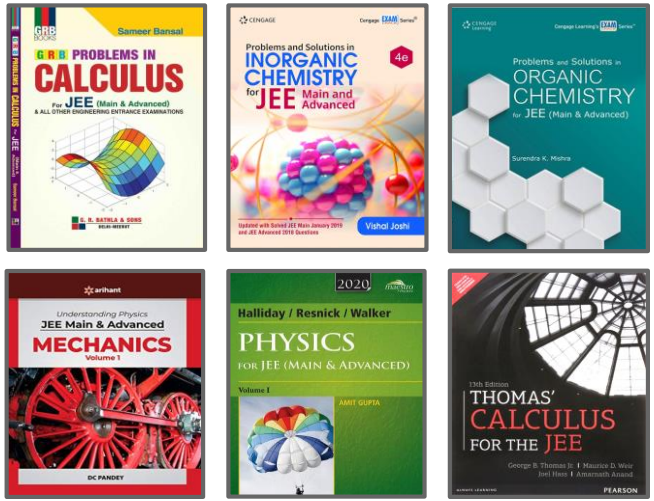

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Adnan
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Ashwin Prasanth
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Tanmay Jain
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Kunal Lalwani
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Utsav Dhanuka
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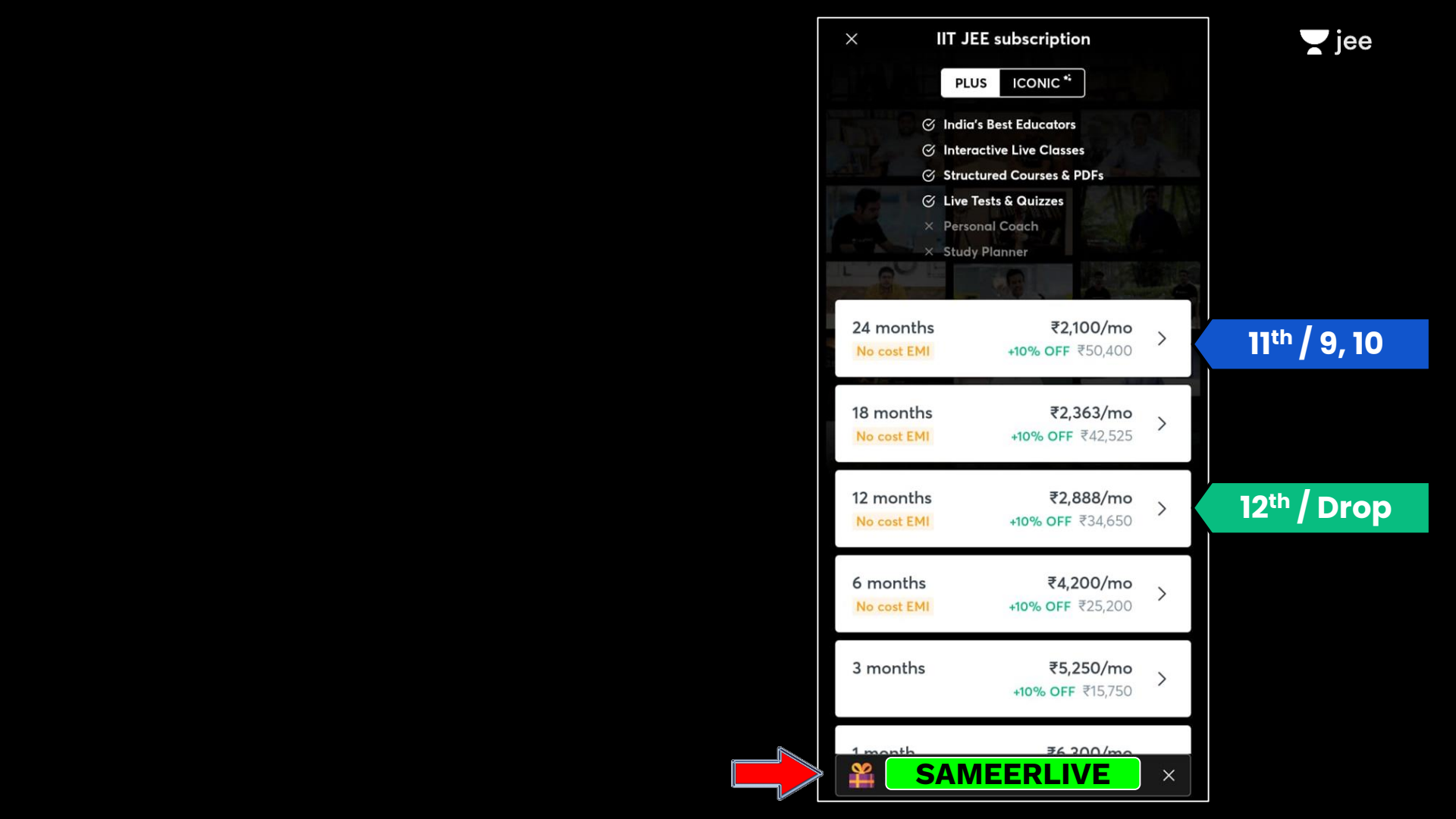
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+10% OFF ₹34,650
6 months
No cost EMI
₹4,200/mo
+10% OFF ₹25,200
3 months
₹5,250/mo
+10% OFF ₹15,750
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LET'S BEGIN!!

Homework Question

Solve: $5\sin x + 6\sin 2x + 5\sin 3x + \sin 4x = 0$

$$5(\sin x + \sin 3x) + 6\sin 2x + \sin 4x = 0$$

$$5(2\sin 2x \cos x) + 6\sin 2x + 2\sin 2x \cos 2x = 0$$

$$(2\sin 2x)(5\cos x + 3 + \cos 2x) = 0$$

$$(2\sin 2x)(5\cos x + 3 + 2\cos^2 x - 1) = 0$$

$$(2\sin 2x)(2\cos^2 x + 5\cos x + 2) = 0$$

$$\Rightarrow (2\sin 2x)(2\cos^2 x + 4\cos x + \cos x + 2) = 0$$

$$\Rightarrow (2\sin 2x)\left(2\cos x(\cos x + 2) + 1(\cos x + 2)\right) = 0$$

$$\Rightarrow (2\sin 2x)(2\cos x + 1)(\cos x + 2) = 0$$

Case-1 : $\sin 2x = 0$

$2x = n\pi$

$$x = \frac{n\pi}{2}$$

Case-2 : $\cos x = -\frac{1}{2}$

$$x = 2n\pi \pm \frac{2\pi}{3}$$

Case-3 : $\cos x = -2$

✗ Reject

4. Converting product to sum or difference

1. $\sin(A + B) + \sin(A - B) = 2 \sin A \cos B$

2. $\sin(A + B) - \sin(A - B) = 2 \cos A \sin B$

3. $\cos(A + B) + \cos(A - B) = 2 \cos A \cos B$

4. $\cos(A - B) - \cos(A + B) = 2 \sin A \sin B$

Solve: sin 5x . cos 3x = sin 6x . cos 2x

$$2\sin 5x \cdot \cos 3x = 2\sin 6x \cos 2x$$

$$\sin(8x) + \sin(2x) = \sin(8x) + \sin(4x)$$

$$\sin 2x - \sin 4x = 0$$

$$\sin 2x - 2\sin 2x \cos 2x = 0$$

$$(\sin 2x)(1 - 2\cos 2x) = 0$$

Case-1: $\sin 2x = 0$

$$2x = n\pi$$

$$\boxed{x = \frac{n\pi}{2}}, \quad n \in I$$

Case-2: $\cos 2x = \frac{1}{2}$

$$2x = 2n\pi \pm \frac{\pi}{3}$$

$$\boxed{x = n\pi \pm \frac{\pi}{6}}$$

$n \in I$

Solve: cosx.cos2x.cos3x = 1/4

$$\cos x \cdot \cos 2x \cos 3x = \frac{1}{4}$$

$$(2\cos 2x)(2\cos x \cos 3x) = 1$$

$$(2\cos 2x)(\cos 4x + \cos 2x) = 1$$

$$2\cos 2x \cos 4x + 2\cos^2 2x - 1 = 0$$

$$2\cos 2x \cos 4x + \cos 4x = 0$$

$$\Rightarrow (\cos 4x)(2\cos 2x + 1) = 0$$

Case-1 : $\cos 4x = 0$

$$4x = (2n+1)\frac{\pi}{2}$$

$$\boxed{x = (2n+1)\frac{\pi}{8}}$$

$n \in I$

Case-2 : $\cos 2x = -\frac{1}{2}$

$$\Rightarrow 2x = 2n\pi \pm \frac{2\pi}{3}$$

$$\Rightarrow \boxed{x = n\pi \pm \frac{\pi}{3}}$$

$n \in I$

Important Results

1. $\sin(A + B).\sin(A - B) = \sin^2 A - \sin^2 B = \cos^2 B - \cos^2 A$

2. $\cos(A + B)\cos(A - B) = \cos^2 A - \sin^2 B = \cos^2 B - \sin^2 A$

Solve: $\cos^2 x + \cos^2 2x + \cos^2 3x + \cos^2 4x = 2$

$$(\cos^2 x - 1) + (\cos^2 2x - 1) + \cos^2 3x + \cos^2 4x = 0$$

$$-\sin^2 x - \sin^2 2x + \cos^2 3x + \cos^2 4x = 0$$

$$(\cos^2 3x - \sin^2 x) + (\cos^2 4x - \sin^2 2x) = 0$$

$$\cos(4x)\cos(2x) + \cos(6x)\cos(2x) = 0$$

$$(\cos 2x)[\cos 4x + \cos 6x] = 0$$

$$(\cos 2x)(2\cos(5x)\cos(x)) = 0$$

$$2\cos x \cos 2x \cos 5x = 0$$

Case-1: $\cos x = 0$

$$x = (2n+1)\frac{\pi}{2}$$

Case-2 $\cos 2x = 0$

$$2x = (2n+1)\frac{\pi}{2}$$

$$x = (2n+1)\frac{\pi}{4}$$

Case-3: $\cos 5x = 0$

$$5x = (2n+1)\frac{\pi}{2}$$

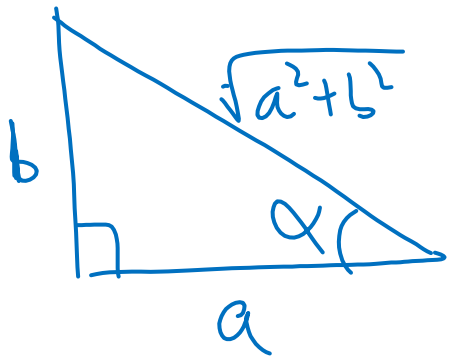
$$x = (2n+1)\frac{\pi}{10}$$

5. Use of form acosx ± bsinx

$$\frac{a}{\sqrt{a^2+b^2}}\cos x + \frac{b}{\sqrt{a^2+b^2}}\sin x = \frac{C}{\sqrt{a^2+b^2}}$$

$\frac{a}{\sqrt{a^2+b^2}} = \cos\alpha$

$\frac{b}{\sqrt{a^2+b^2}} = \sin\alpha$



$$\cos x \cos \alpha + \sin x \sin \alpha = \frac{c}{\sqrt{a^2+b^2}}$$

$$\cos(x-\alpha) = \frac{c}{\sqrt{a^2+b^2}}$$

Solve: sin 2x + cos 2x = 1

$$\frac{(1)}{\sqrt{2}}\sin 2x + \frac{(1)}{\sqrt{2}}\cos 2x = \frac{1}{\sqrt{2}}$$

$$(\cos 2x)\left(\cos\frac{\pi}{4}\right) + (\sin 2x)\left(\sin\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$$

$$\cos\left(2x - \frac{\pi}{4}\right) = \cos\frac{\pi}{4}$$

$$2x - \frac{\pi}{4} = 2n\pi \pm \frac{\pi}{4}$$

(+) : $2x - \frac{\pi}{4} = 2n\pi + \frac{\pi}{4} \Rightarrow \boxed{x = n\pi + \frac{\pi}{4}}$

(−) : $2x - \cancel{\frac{\pi}{4}} = 2n\pi - \cancel{\frac{\pi}{4}} \Rightarrow \boxed{x = n\pi}$

Solve: $\sqrt{2}.\sec\theta + \tan\theta = 1$

$$\frac{\sqrt{2}}{\cos\theta} + \frac{\sin\theta}{\cos\theta} = 1$$

$$\sqrt{2} + \sin\theta = \cos\theta$$

$$\cos\theta - \sin\theta = \sqrt{2}$$

$$\frac{1}{\sqrt{2}}\cos\theta - \frac{1}{\sqrt{2}}\sin\theta = 1$$

$$\cos\left(\theta + \frac{\pi}{4}\right) = 1$$

$$\Rightarrow \left(\theta + \frac{\pi}{4}\right) = 2n\pi$$

$$\boxed{\theta = 2n\pi - \frac{\pi}{4}}$$

Find the number of solution of the equation in [0, 2π],
tan (5π cos α) = cot (5π sin α)

$$\tan(5\pi\cos\alpha) = \tan\left(\frac{\pi}{2} - (5\pi\sin\alpha)\right)$$

$$5\pi\cos\alpha = n\pi + \left(\frac{\pi}{2} - 5\pi\sin\alpha\right)$$

$$5\pi(\cos\alpha + \sin\alpha) = (2n+1)\frac{\pi}{2}$$

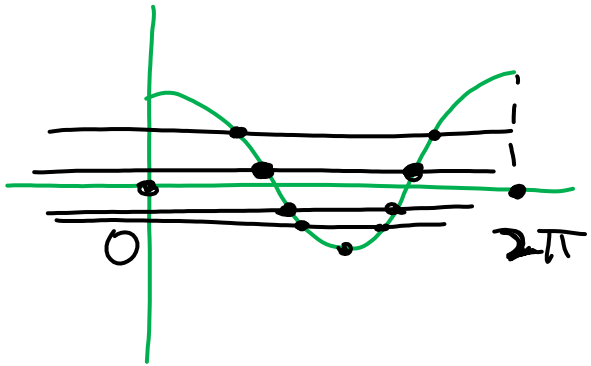
$$\cos\alpha + \sin\alpha = \frac{(2n+1)}{10}$$

$$\frac{1}{\sqrt{2}}\cos\alpha + \frac{1}{\sqrt{2}}\sin\alpha = \frac{(2n+1)}{10\sqrt{2}}$$

$$\cos\left(\alpha - \frac{\pi}{4}\right) = \left(\frac{2n+1}{10\sqrt{2}}\right)$$

$$\Downarrow$$

$$[-1, 1]$$



$$n = 0, \pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 6, -7$$

$$\therefore \text{Total sol}^{n} = \boxed{28}$$

6. Use of substitution sinx ± cosx = t.

(1) Let

$\sin x + \cos x = t$

$(\sin x + \cos x)^2 = t^2$

$1 + 2\sin x \cos x = t^2$

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

(2) Let

$\sin x - \cos x = t$

$1 - 2\sin x \cos x = t^2$

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

Solve: $\sin 2x + 5\sin x + 1 + 5\cos x = 0$

$$5(\sin x + \cos x) + 2(\sin x \cos x) + 1 = 0$$

Let's $\sin x + \cos x = t$

$$\Rightarrow \sin x \cos x = \left(\frac{t^2 - 1}{2}\right)$$

$$5t + 2\left(\frac{t^2 - 1}{2}\right) + 1 = 0$$

$$t^2 + 5t = 0$$

$$t(t+5) = 0$$

Case-1: $t = 0$

$$\sin x + \cos x = 0$$

$$\sin x = -\cos x$$

$$\tan x = -1$$

$$x = n\pi - \frac{\pi}{4}$$

Case-2: $t = -5$

$$\sin x + \cos x = -5$$

$\sin x + \cos x \in [-\sqrt{2}, \sqrt{2}]$

X Reject

Solve : 3cosx + 3sinx + sin3x - cos3x = 0

H.W

#JEELiveDaily Schedule

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11th

Namo Sir | Physics

6:00 - 7:30 PM

Ashwani Sir | Chemistry

7:30 - 9:00 PM

Sameer Sir | Maths

9:00 - 10:30 PM

12th

Jayant Sir | Physics

1:30 - 3:00 PM

Anupam Sir | Chemistry

3:00 - 4:30 PM

Nishant Sir | Maths

4:30 - 6:00 PM

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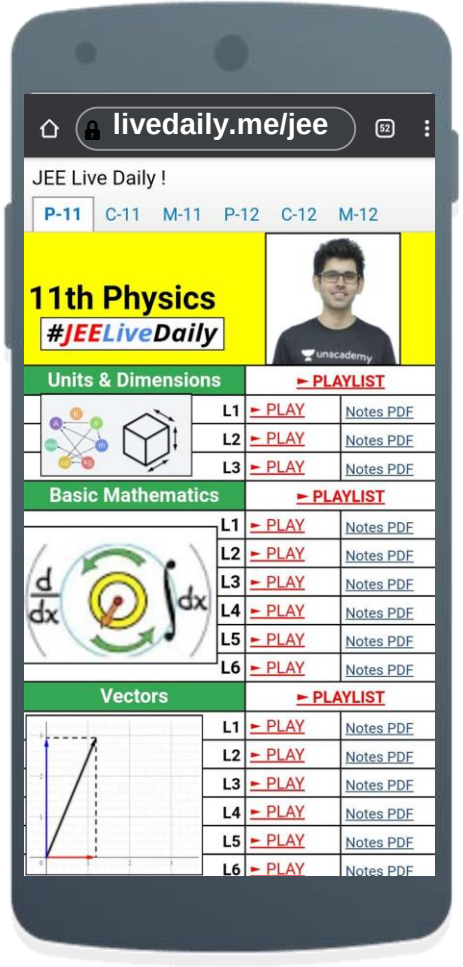

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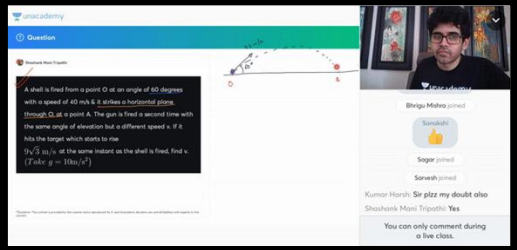

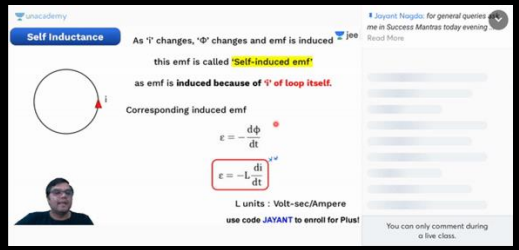

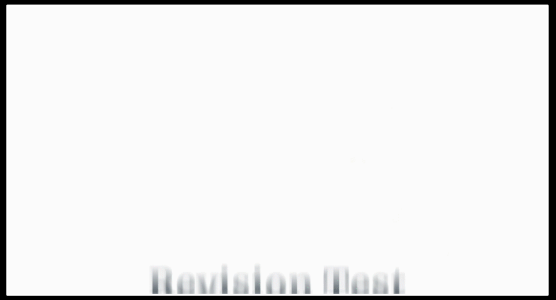

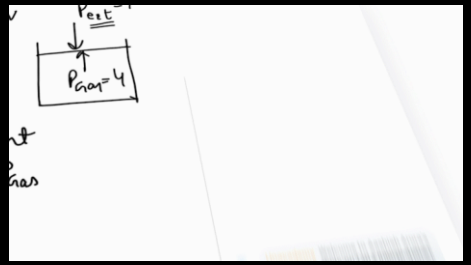

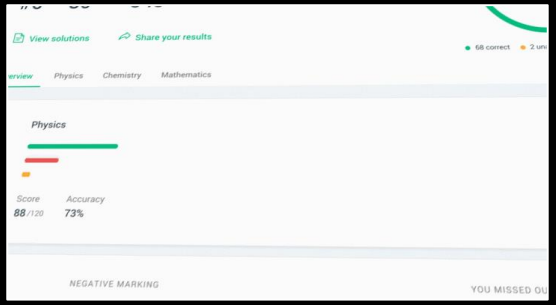

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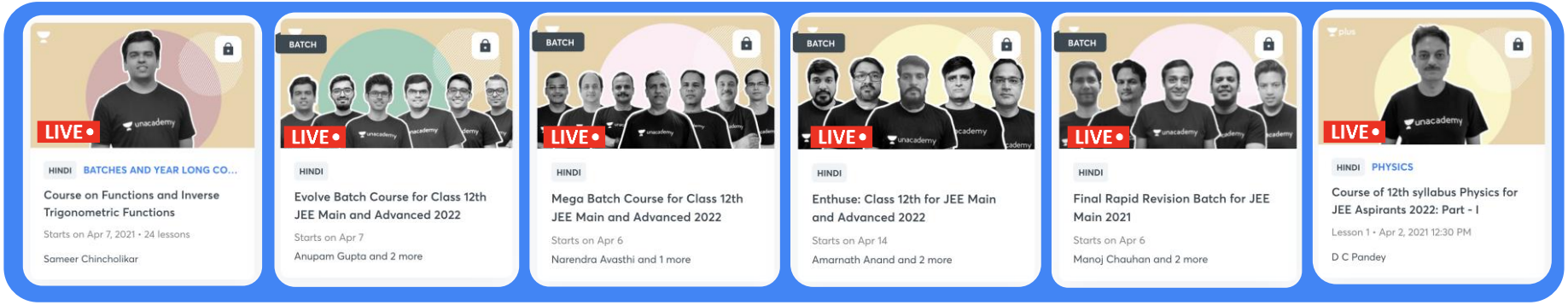

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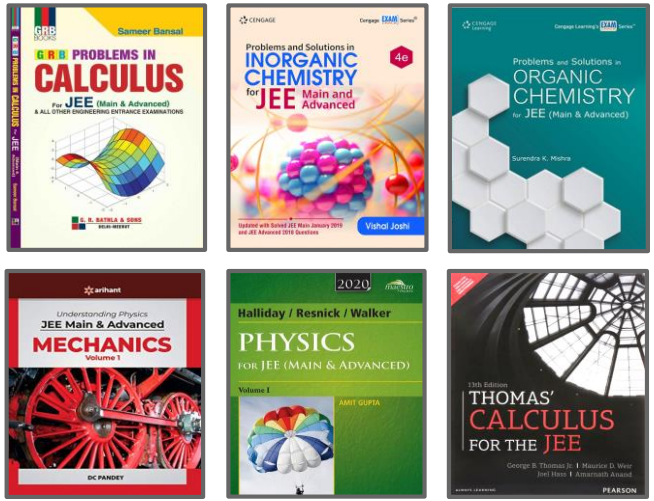

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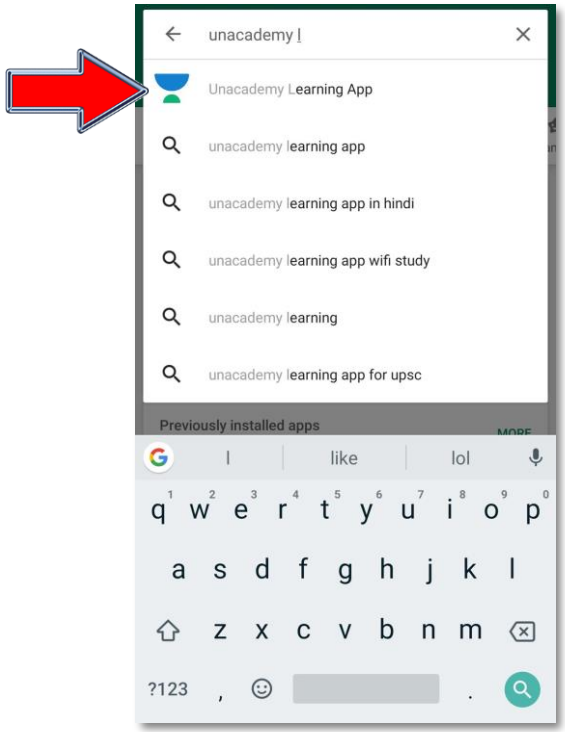
Step 1



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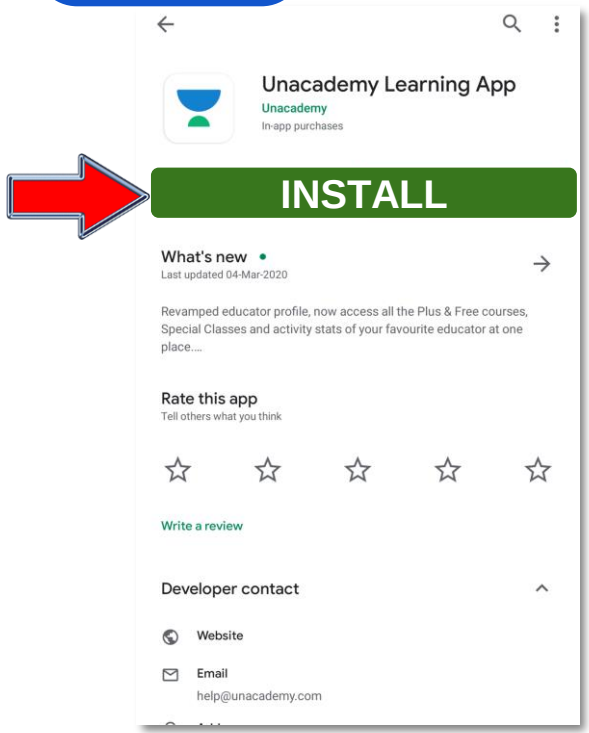

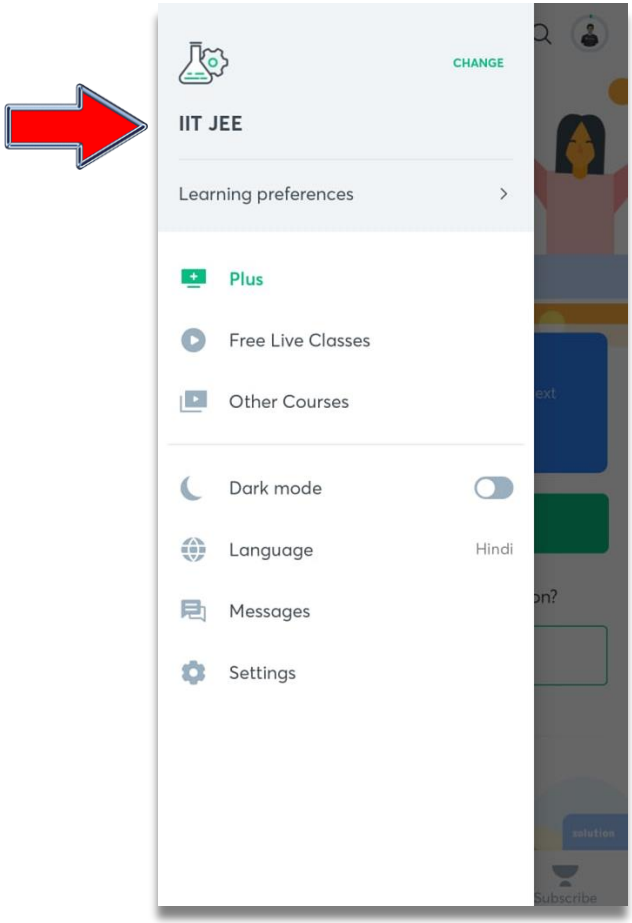
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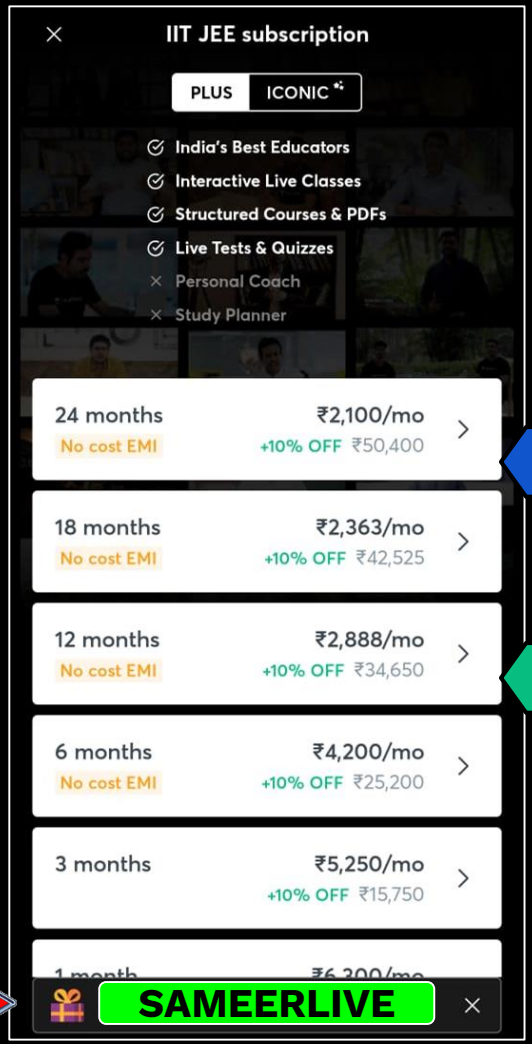

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Emerge Batch (Class 11th) : JEE Main & Advanced 2023	Starts on 26th May 2021
Emerge Batch (Class 11th) : JEE Main & Advanced 2023	Starts on 27th May 2021
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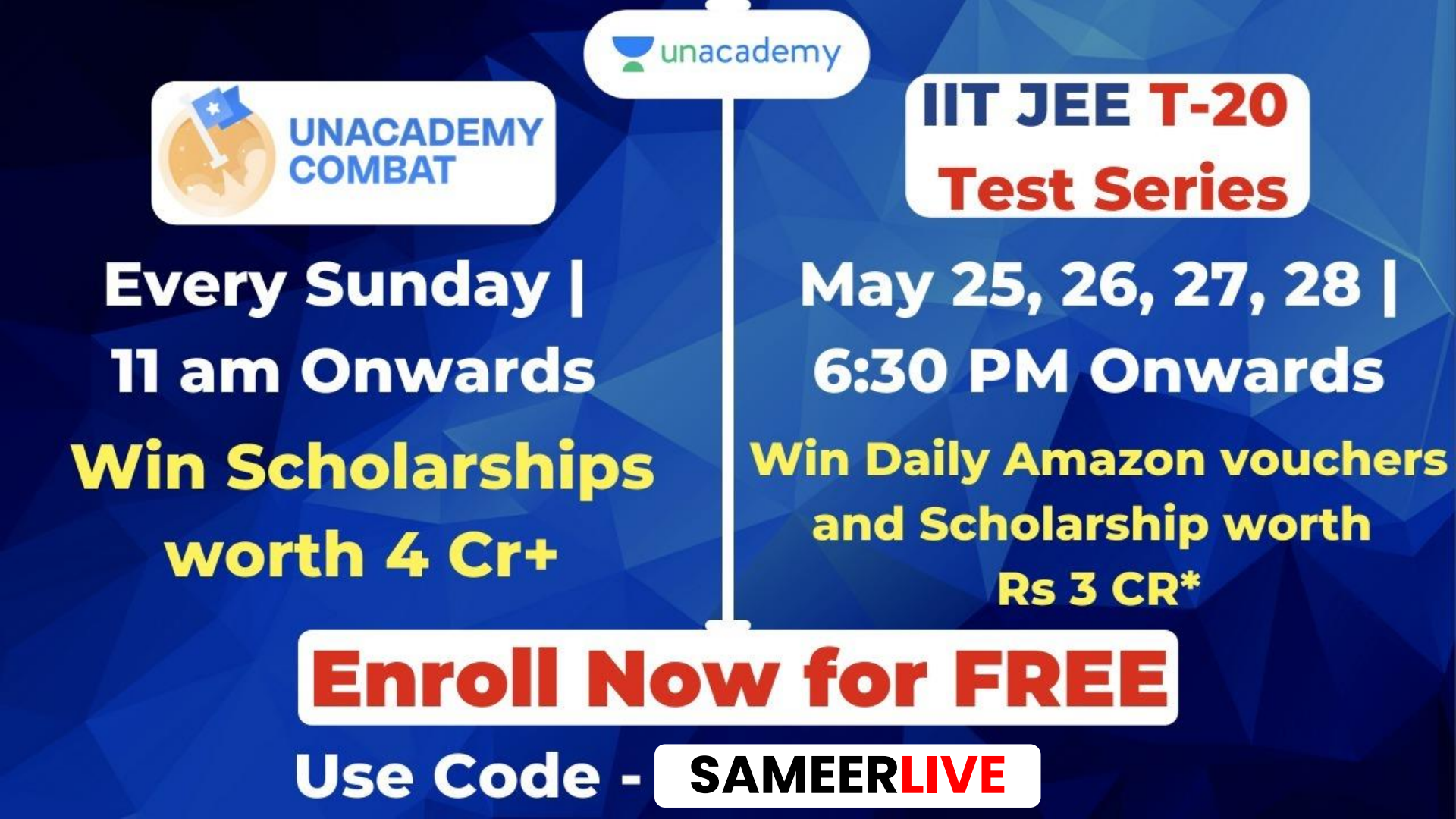
Sanjivani Batch : MHT-CET 2021	Started on 26th May 2021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